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78

PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS
SECTION B, ELECTRICAL ENGINEERING

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VOLUME 55 **FEBRUARY 1952** NUMBER 650

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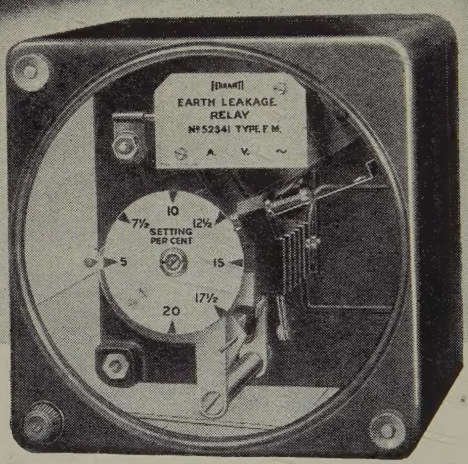

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RELATED SUBJECTS CONTAINED IN SECTION B (ELECTRICAL ENGINEERING ABSTRACTS)

Mechanical testing
Non-destructive testing
Industrial radiography
Electrical and magnetic measurements and instruments
Electronic relays and counters
Automatic control mechanisms
Applied electrochemistry
Photocells
Thermionic tubes
Cathode-ray tubes
X-ray tubes
Amplifiers
Radiocommunication
Mechanical engineering
Illumination
Metallurgy

LIST OF JOURNALS

The following list supplements the List of Journals published with the January number of Volume 53 (1950) and the Supplements published with the Indexes to Volume 53 (1950) and Volume 54 (1951). Reprints of the List of Journals (1950) and the Supplements (1950, 1951) can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2, price 2s. post free.

The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

Journals marked * are not received regularly.

**Arh. Kem.*	*Arhiv zu Kemiju.* 20 Marulicev trg, Zagreb (Croatia).
**Comment. Math. Helv.*	*Commentarii Mathematici Helvetici.* [Abstracted by *Mathematical Reviews.*]
Electronic Appl. Bull.	*Electronic Application Bulletin.* N. V. Philips' Gloeilampenfabrieken, Eindhoven.
**J. Aero. Sci.*	*Journal of Aeronautical Science.* [Abstracted by *Mathematical Reviews.*]
Meteorol. Abstr.	*Meteorological Abstracts and Bibliography.* 3 Joy Street, Boston 8, Massachusetts.
**Meteorol. i Gidrolog.*	*Meteorologiia i Gidrologiia.* [Abstracted by *Meteorological Abstracts.*]
Meteorol. Rep. Meteorol. Off. [*Lond.*]	*Meteorological Reports. Meteorological Office.* [Air Ministry.] H.M. Stationery Office, Kingsway, W.C.2.
**Oil Gas J.*	*Oil and Gas Journal.* [Abstracted by Metropolitan-Vickers Electrical Co.]
**Proc. Ass. Amer. Railr. Elect. Sect. Engng Mech. Div.* (1950)	*Proceedings of the Joint Annual Meetings of the Association of American Railroads.* Operations and Maintenance Department, Electrical Section, Mechanical and Engineering Divisions, 59 East Van Buren Street, Chicago 5.
**Rev. Soc. Cubana Cienc. Fis. Mat.*	*Revista de la Sociedad Cubana de Ciencias Fisicas y Matematicas.* [Abstracted by *Mathematical Reviews.*]
Scientia [*Valparaiso*]	*Scientia.* Universidad Tecnica Federico Santa Maria, Casilla 110-V, Valparaiso.
Tech. Rep. Nat. Adv. Comm. Aeronaut.	*Technical Reports of the National Advisory Committee for Aeronautics.* [Abstracted by *Mathematical Reviews.*]
Trans Amer. Math. Soc.	*Transactions of the American Mathematical Society.* [Abstracted by *Mathematical Reviews.*]

New Journals

Bull. Int. Rly Congr. Ass. Elect. Tract. Rlys [*English Ed.*]	*Bulletin of the International Railway Congress Association. Electric Traction on the Railways. English Edition.* 19 rue du Beau-Site, Brussels. Vol. 1, No. 1 dated June, 1950. Four issues published in 1950, six in 1951. Single copy 70 Belgian francs (excluding postage). Annual subscription: Belgium—350 Belgian francs; Universal Postal Union—400 Belgian francs.
Bull. Res. Coun. Israel	*Bulletin of the Research Council of Israel.* P.O.B. 607, Jerusalem. Europe: North Holland Publishing Company, Amsterdam. America: Interscience Publishers, New York, N.Y. Vol. 1, No. 1–2 issued March, 1951. Four issues annually. Annual subscription: IL 2000 post free, single copy 500 pruta, double copy 750 pruta.
Telecommunications [*Jabalpur*]	*Telecommunications*, Jabalpur (M.P.), India. Vol. 1, No. 1 dated June, 1951. Issued under the direction of the Indian Posts and Telegraphs Department, Ministry of Communications, Government of India, by the Additional Chief Engineer, Posts and Telegraphs, Jabalpur. Inland Rs. 2/- per copy (post free) and foreign 3 Shillings per copy (post free).

Erratum

Author Index (1950), p. 1060, column 1: ARENS, H.: *for* 3755 *read* 3655

MATHEMATICS 51

513.882 : 621.3.01

712. Hilbert transforms and the Bayard–Bode relations. F.-H. RAYMOND. *Ann. Télécommun.*, **6**, 262–72 (*Oct.*, 1951) *In French.*

A mathematical paper. The Cauchy theorem is used to derive Hilbert transforms, and the latter lead to the Bayard–Bode relations. The article is an expository one, written for readers who are engineers. Physical applications, such as network analysis and feedback amplifier design, are briefly discussed.

L. S. GODDARD (R)

517.5

713. On functions of delta-functions. B. GROSS. *Z. Naturforsch.*, **6a**, 676–9 (*Nov.*, 1951) *In German.*

The physical significance of the new equation is discussed and its validity for general processes established.

Z. F. WOJNAR

517.544.2 : 517.996.9

714. Tables of Green's functions, Fourier series, and impulse functions for rectangular co-ordinate systems. J. J. SMITH. *Trans Amer. Inst. Elect. Engrs*, **70**, 22–30 (*Pt* 1, 1951).

The functions arise in the solutions of partial differential equations. Choosing the appropriate entry for the space and boundary conditions specified, solutions for other conditions can be found by using auxiliary theorems. Tables are given covering steady state and instantaneous plane, line and point sources in 1, 2 and 3 dimensions, together with instructions for use and simple examples.

B. L. COLEMAN

517.94

715. The impulse integral, a counterpart of the Duhamel impact integral. R. LUEG, M. PÄSLER AND W. REICHARDT. *Ann. Phys.* [*Lpz.*] **9**, 307–15 (*No.* 6–7, 1951) *In German.*

The Duhamel integral is of the "Faltung" type, and arises in the solution, by a Laplace-transform method, of linear differential equations, when the initial conditions are impulsive. The integral is transformed into the simpler impulse integral. Its use in spectral analysis is indicated.

L. S. GODDARD

518.4 : 621.3.017.7

716. The linear representation of heating curves and of related curves of exponential type and their practical application. A. RITTER. *Elektrotech. u. Maschinenb.* [*EuM*] **68**, 457–61 (*Oct.* 1, 1951) *In German.*

It is shown how curves of the form $y = a + b\{1 - \exp(-\alpha t)\}$, may be represented linearly by using exponential (or logarithm) graph paper. Such curves arise in the theory of heat, theory of current and potential in a coil possessing self-induction or capacitance, and in various aperiodic mechanical systems. Simple graphical procedures are given for evaluating the mean, and mean square, of the function. An electrical example is used to illustrate the method.

L. S. GODDARD (R)

518.5 : 535.312

An investigation of the errors of co-ordinate machines using light beams. *See Abstr.* 861

518.5 : 621.314.1

717. A quarter-square multiplier using a segmented parabolic characteristic. B. CHANCE, F. C. WILLIAMS, C.-C. YANG, J. BUSSER AND J. HIGGINS. *Rev. Sci. Instrum.*, **22**, 683–8 (*Sept.*, 1951).

A circuit for multiplying two varying voltages based on the "quarter-square" method has been developed. A segmented non-linear element is used for squaring, and a time-sharing scheme permits the use of a single squaring element instead of duplicate elements as in previous designs. The circuit has a time delay of less than 40 μsec (0–67%) and has an accuracy of better than $\pm 1\%$. The original circuit was designed to operate only in the first quadrant. Various methods for including the four quadrants are discussed.

A.

518.5 : 621.385.832 : 621.318.572

718. Improvements in cathode-ray tube storage: application to a parallel type of digital computer. G. H. PERRY. *Nature* [*Lond.*] **168**, 372–3 (*Sept.* 1, 1951).

Interaction (and spacing) is more serious than in serial working. It has been reduced by (*a*) reducing net beam current by 20% by a "double-dot" system and (*b*) increasing the final anode voltage of the c.r.t. from 1 to 1·5 kV to give a finer focused spot, and working over a different part of the screen secondary emission characteristic, reducing digit separation from 1·8 to 0·8 mm. Reduction of the effects of screen imperfections have been achieved by (*a*) modulation of the beam at 5 Mc/s and also by (*b*) the defocus-focus system, which is more advantageous, the duration of re-filling pulses being reduced to 0·8 μsec (compared with 2 μsec with the double-dot system). Screens have been used with this system which had been rejected for use with others. The system is also suitable for serial storage providing a square pattern of 1 024 digits, in which any digit may have its neighbours brightened up 64 times before being regenerated itself.

A. J. KENNEDY

519.21

719. Runs in a sequence of observations. P. V. KRISHNA IYER AND A. S. PRAKASH RAO. Letter in *Nature* [*Lond.*] **168**, 557 (*Sept.* 29, 1951).

A difference equation for the probability generating function is obtained, and the first two moments deduced.

N. L. JOHNSON

519.25

720. How best to correct, in an analysis of an experiment, for the uncertainty connected with the discrete and discontinuous nature of the data. P. VERNOTTE. *C.R. Acad. Sci.* [*Paris*] **233**, 735–6 (*Oct.* 1, 1951) *In French.*

The method described in Abstr. 8435 (1951) is referred to and it is shown that owing to the irregularity of the experimental errors the inclusion or exclusion of one or more experimental value within a partial interval may lead to difficulty. A simple method for minimizing this is indicated, and applied by determining the representative polynomial $(Ax^2 + Bx + C)$ within the interval (0–1).

S. WEINTROUB

519.283

721. A Monte Carlo method for solving a class of ntegral equations. R. E. CUTKOSKY. *J. Res. Nat. Bur. Stand.* [*Wash.*] **47**, 113–15 (*Aug.*, 1951).

This note describes a random walk equivalent to the Neumann series solution of an integral equation. A diffusion analogy and the problem of importance sampling are discussed briefly. A.

519.4

722. Modular representations of symmetric groups. D. E. LITTLEWOOD. *Proc. Roy. Soc. A*, **209**, 333–53 (*Nov.* 7, 1951).

An analysis of partitions is made by considering the congruence of sets of numbers, which is to some extent equivalent to, but more far-reaching than Nakayama's method of hooks. A proof is given of Nakayama's conjecture concerning the *p*-blocks of symmetric group characters which is much simpler than the recent proof by Brauer and Robinson. The *p*-residue and *p*-quotient of a partition are defined, and a formula is obtained relating to symmetric group characteristics. A procedure is described whereby the mode of separation in every case may be determined of the 0-characters of the symmetric groups into *p*-characters. The method of *p*-residues and *p*-quotients is employed to give a method of expansion for the plethysm of *S*-functions which is unambiguous and yet reasonably concise. A.

ASTRONOMY . ASTROPHYSICS . GEODESY 52

523.165

723. An attempt to measure the annual parallax or proper motion of four radio stars. F. G. SMITH. Letter in *Nature* [*Lond.*] **168**, 962–3 (*Dec.* 1, 1951).

The differences in R.A. of the four brightest northern sources are examined interferometrically on wavelengths of 3·7 and 1·4 m. No angular movements which could not be attributed to ionospheric refraction were observed, upper limits of parallax being $\frac{1}{20}$ parsec for 05·01 and 12·01, and $\frac{1}{3}$ parsec for 19·01 and 23·01. M. W. OVENDEN

523.4

724. Unstable planetary configuration. W. H. RAMSEY. *Nature* [*Lond.*] **168**, 676–9 (*Oct.* 20, 1951).

A new type of planetary instability is deduced from the author's new theory of the internal structure of the earth, which attributes the sharp core discontinuity in the earth's density to a phase transition under pressure [Abstr. 3274–5 (1951)]. Quantitative representations are given of the behaviour of the mass of a planet as a function of its central pressure, and of the relation between the total energy of a planet and its total radius. All available observational evidence, pointing in favour of the new views, is critically examined in detail. A. BEER

523.48

725. The nature of Pluto and Triton. A. DAUVILLIER. *C.R. Acad. Sci.* [*Paris*] **233**, 901–3 (*Oct.* 22, 1951) *In French.*

It is suggested that the two bodies are actually twin members of the family of giant planets, which have been reduced to a dense core (cf. the terrestrial planets) because of insufficient initial mass, their high initial temp. resulting in evaporation of the lighter elements. D. R. BARBER

523.53

726. Variation of meteor echo rates with radar system parameters. D. W. R. MCKINLEY. *Canad. J. Phys.*, **29**, 403–26 (*Sept.*, 1951).

Observations made with crossed-polarization radar system systems do not support the suggestion that the ionized meteor trail may act as a strong filter-polarizer of the incident radio wave. Experiments have been carried out to determine the variation of normal meteor echo rates with transmitter power, aerial gain and radio wavelength, and all confirm Lovell's scattering formula, provided that account is taken of the effective broadening of the scattering pattern of the meteor trail with increasing wavelength. The limiting sensitivity of the 9·22 m 200 kW radar is determined to be about 9th magnitude. During a strong visual shower the observed increase in visual rates and low-power radar rates, compared to high-power radar rates, is explained by assuming that the magnitude distribution of the shower meteors differs from the normal non-shower distribution. A.

523.59

727. Automatic recording of the zodiacal light. V. H. REGENER. *Z. Naturforsch.*, **6a**, 632–4 (*Nov.*, 1951) *In German.*

A specially designed p.e. photometer scans the sky automatically in a 10 min cycle. The cell receives light from a 0·3° solid angle, and scanning is effected in strips, 3° wide by 180° long, declination being changed by 3° after each sweep. The total range in dec. is from −18° to +39°. D. R. BARBER

523.71

728. On the problem of the solar constant. M. NICOLET. *Ann. Astrophys.*, **14**, 249–65 (*No.* 3, 1951) *In French.*

A determination of the spectral distribution of the solar radiation is given on the basis of observations of the solar continuum and the absorption by Fraunhofer lines. The ultraviolet and infrared corrections suggested by Schatzman and Allen and those adopted by Abbot are compared. The mean value of the solar constant should be corrected to allow for the exact spectral distribution between 1 μ and 2 μ, where the more important correction appears. If a value of 1·94 cal min^{-1} cm^{-2} is assumed for the standard value of the Smithsonian Institution, a new estimate of the solar constant gives 1·98 cal min^{-1} cm^{-2}. However an absolute value must be given by new absolute measurements of the solar emission in certain spectral ranges or by direct measurement by rockets. The error of the solar constant is probably not less than ±5%. A.

523.71

729. On the possible electromagnetic nature and origin of the observed fluctuations in the diameter of the sun. L. GIALANELLA. *Atti Accad. Naz. Lincei (R.C. Cl. Sci. Fis. Mat. Nat.)* **11,** 60–3 (*July–Aug.*, 1951) *In Italian.*

Daily measurements of the solar diameter carried out regularly in Rome since 1874 have brought to light variations in this diameter which may be analysed into a fundamental wave of period 22–23 years and a secondary wave of period 6–8 years. These periods agree with those of solar spots and this may be considered as evidence for the validity of Schwarzschild's model in which a coupling is postulated between mechanical and magnetic oscillations of a star. In this model the observed periods would be produced by a general field of about 1 000 gauss.

L. PINCHERLE

523.72

730. Observation of the annular eclipse of the sun on 1st September 1951. F. BOSSON, E.-J. BLUM, J.-F. DENISSE, E. LEROUX AND J.-L. STEINBERG. *C.R. Acad. Sci. [Paris]* **233,** 917–19 (*Oct.* 22, 1951) *In French.*

Measurements of the radiofrequency emission from the sun, during the eclipse, were made on wavelengths of 3 cm and 1·78 m. At 1·78 m the apparent solar diameter is 1·4 times the optical diameter, the radiation coming equally from the optical and coronal areas. At 3 cm the measurements confirm that a rapid increase in intensity occurs near the limb.

G. D. SIMS

523.72

731. A model solar atmosphere deduced from measurements of the continuous spectrum background. R. PEYTURAUX. *C.R. Acad. Sci. [Paris]* **233,** 1083–5 (*Nov.* 5, 1951) *In French.*

A continuation of previous work [Abstr. 4049, 7463 (1951)]. The model proposed appears a more exact solution than that of De Jager [*Bull. Astron. Inst. Netherlands*, **11,** 291–8 (1951)]. D. R. BARBER

523.741, 523.877

732. The applicability of Kirchhoff's law to the photosphere of the sun and of the stars of the class AO. S. L. BELOUSOV. *Dokl. Akad. Nauk, SSSR,* **79,** 763–6 (*No.* 5, 1951) *In Russian.*

Mustel [Abstr. 6972 (1950)] has shown that Kirchhoff's law $j_\nu = k_\nu B_\nu$ can be applied to the emitting substance of the photosphere only if the emission temperature T is equal to the kinetic temperature of the free electrons T_K. A mathematical analysis is carried out for the possible difference between the 2 temperatures, which may be due to the free electrons expending their energy on the excitation and ionization of atoms by collisions. It has been shown that inelastic collisions in the photospheres of the sun and of the class AO stars do not cause a considerable deviation from Kirchhoff's law, although in the case of the sun these deviations can attain 20% for the visible spectrum. F. LACHMAN

523.742

733. Remarks on the integral equation of darkening at the sun's limb. D. BARBIER. *Ann. Astrophys.*, **14,** 316–17 (*No.* 3, 1951) *In French.*

The solutions of this equation, obtained by Lundblad (1923) and Plaskett (1932) are critically reviewed. A new method is proposed which appears to satisfy Abbot's spectroscopic observations rather more exactly. D. R. BARBER

523.746

734. On the magnetic flux through sunspot-groups of the classes βγ and γ. W. GROTRIAN AND H. KÜNZEL. *Z. Astrophys.*, **29,** 173–6 (*No.* 2, 1951) *In German.*

Calculation of the magnetic flux through 8 large sunspot-groups (up to 3 500 gauss), on the basis of Mount Wilson observations, supplementing a previous paper by the same authors [Abstr. 3284 (1951)]. Again special attention is paid to the variation with time; comparisons are made with Giovanelli's theory.

A. BEER

523.755

735. The solar corona of July 28, 1851. M. WALDMEIER. *Z. Astrophys.*, **30,** 1–7 (*No.* 1, 1951) *In German.*

A photometric study of the oldest picture of the solar corona, a daguerreotype that belongs to the Swiss Federal Observatory. From the isophotes the Ludendorff coefficients characterizing the shape of the corona have been derived. A.

523.755

736. The evaporation of the solar corona. K. O. KIEPENHEUER. *Z. Naturforsch.*, **6a,** 627–32 (*Nov.*, 1951) *In German.*

It is demonstrated that at least 10^8 g/sec coronal material is lost to interplanetary space by direct evaporation via the ribbon-like coronal appendages.

D. R. BARBER

523.841.9

737. Gaseous envelopes in close binaries. O. STRUVE. *Observatory,* **71,** 197–8 (*Oct.*, 1951).

A classification of eclipsing binaries into 5 groups is suggested, according to the relative luminosities, masses, spectra and radii of the components. A brief summary is given of the observed spectroscopic effects in each group, with the probable structure of the surrounding envelopes, gas streams and areas of eruptive prominences. D. L. EDWARDS

523.852.21

738. A statistical criterion for assessing "globule" phenomena. J. MEURERS. *Z. Astrophys.*, **29,** 189–97 (*No.* 2, 1951) *In German.*

A method is described which enables differentiation to be made between random regions devoid of normal star population, and the small dark nebulae first called "globules" by Bok and Reilly [Abstr. 1710 (1947)]. D. R. BARBER

523.854.3

739. Remarks on the interpretation of the asymmetry of the motions of high-velocity stars. H. SCHMIDT. *Astron. Nachr.*, **279,** 157–8 (*April*, 1951) *In German.*

It is suggested that the symmetry is a consequence of the finite extension, or perhaps finite age, of the galaxy. R. A. NEWING

523.872

740. A photoelectric differential classification of A and F stars. M. RUDKJØBING. *Ann. Astrophys.*, **14,** 272–7 (*No.* 3, 1951).

Metallic-line A stars and comparison stars of spectral classes A and F have been observed photo-

electrically with the use of interference filters for the determination of colours and of relative intensities of strong lines. Three intensity ratios are shown to determine with a high degree of certainty in which of two groups of stars each observed star belongs. The metallic-line stars are found to belong to the same group as do the A stars of the Ursa Major cluster. A.

523.877

741. Quasi-homologous stellar structures. E. SCHATZMAN. *Ann. Astrophys.*, **14**, 278–93 (*No.* 3, 1951) *In French.*

By an entirely mathematical treatment it is shown that (i) Certain giant stars form an homologous sequence, the stellar nucleus showing variable composition through the series. The energy loss is due to proton-proton reactions. (ii) The dwarf and sub-dwarf stars may be divided into two sub-groups, according as the energy loss is due either to H or to C chain-reactions. The intersection of the two sequences is explained by difference in chemical composition. D. R. BARBER

523.877

742. An estimate of the relative helium content of the early-type stars. A. B. UNDERHILL. *Canad. J. Phys.*, **29**, 447–57 (*Sept.*, 1951).

The relative abundance of H to He in O-type atmospheres is estimated by a comparison of the computed strength of the He II line $\lambda 4541$ with observed values. This indicates that the abundance ratio H : He lies in the range 20 to 25, that is, the relative abundance of He is reduced by a factor of $\frac{1}{3}$ to $\frac{1}{2}$ from the amounts estimated by several authors by other spectroscopic methods. It is shown that the O9·5 V model atmosphere gives a fair representation of a late O-type main-sequence atmosphere, and that the computations can best be reconciled with observation by reducing the relative abundance of He to about 4 or 5% by number, the rest of the stellar atmosphere being effectively pure H. The computations for the O5 model atmosphere are not in agreement with this result, but reasons are given for believing that the O5 model atmosphere does not give a good representation of an early O-type stellar atmosphere, and that consequently the results obtained from this model atmosphere are not of equal weight to those obtained from the O9·5 model atmosphere. A.

PHYSICS 53

53 : 37.01

743. Procedure in industrial physics and its implications for education. R. S. SILVER. *Brit. J. Appl. Phys.*, **2**, 241–5 (*Sept.*, 1951).

An attempt is made to analyse and illustrate the general method of procedure in industrial research. Attention is mainly directed to the methods of thought which are operative and which are considered to govern decisions on experimental work and on its application in design. It is suggested that the fact that theoretical concepts in industrial research need not be regarded as valid in an absolute sense outside the context of the particular problems, is of considerable importance. It arises because of the pressure of time and the need for short-cut methods and quick action. It therefore allows a freedom of concept, which carries with it the demand and responsibility to conceptualize as clearly and as widely as possible. The way in which existing training in rigid mathematical physics assists or hinders this process of thought is discussed. It is concluded that an advanced theoretical training is of considerable value, although it is suggested that a supplementary advanced education in non-technical subjects is also desirable. A.

53 : 378.962

744. Impressions of a discussion on technical universities. N. CLARKE. *Brit. J. Appl. Phys.*, **2**, 245–8 (*Sept.*, 1951).

A discussion held by the Education Group of The Institute of Physics on the possible establishment in Great Britain of a Technical University.

53 : 530.145

745. The structure of physical theories. P. DES-TOUCHES-FÉVRIER. *Paris, Presse Universitaires de France* (1951) 423 *pp. In French.*

Logic is regarded, not as a universal *a priori* system, but as one to be adapted to the domain of investigation in which it is used. The formal structure of physical theories is examined in order to set up a "calculus of empirical propositions." From a discussion of the content of classical theories it is concluded that the associated structure is necessarily a two-valued logic L_0; modern quantum theories involving principles of uncertainty and complementarity are shown to imply a fundamental change in logical structure and to lead to a 3-valued system not reducible to L_0. A formal structure is set up for the most general type of physical theory, ideas of measurement and prediction being subjected to detailed analysis, and the classification of theories is discussed. It is demonstrated that "objective" theories involve L_0 and must be deterministic, while "subjective" theories, involving essential interaction between system and observer, cannot be described in terms of L_0 and must be indeterministic. The book is concluded with a detailed analysis of wave mechanics, and it is maintained that all future theories must involve indeterminacy. R. A. NEWING

53 : 530.145

746. On the situation in theory of knowledge problems and the use of a three-valued logic in quantum theory. H. REICHENBACH. *Z. Naturforsch.*, **6a**, 569–75 (*Nov.*, 1951) *In German.*

A discussion of "causal anomalies" in theoretical physics, emphasizing that, whereas two-valued logic is adequate for questions concerning physical observables, the discussion of physical unobservables requires a three-valued logic. R. H. DALITZ

53.081.3/.4

747. Units and standards of measurement employed at the National Physical Laboratory. I. Length, mass, time; volume, density and specific gravity, force and pressure. *Department of Scientific and Industrial Research. London, H.M. Stationery Office* (1951) 12 *pp.*

This pamphlet describes the standards of the three fundamental units of measurement, and definitions of them are given in the International Metric and British Imperial systems. The derived units are also described, and the values of the standards and bases of measurement employed in work involving these units are given. The absolute value of the acceleration due to gravity at the Laboratory is included.

53.087.5 : 771.3

Camera for recording on 35 mm film. *See Abstr.* 1373

FUNDAMENTALS 530.1

530.112

748. Is there an æther? P. A. M. DIRAC. Letter in *Nature* [*Lond.*] **168,** 906–7 (*Nov.* 24, 1951).

With the development of quantum mechanics, the concept of an ether is no longer necessarily incompatible with relativity requirements. The ether velocity would be subject to uncertainty relations, and the corresponding wave function for a perfect vacuum, which would be an idealized state, might meet the requirements of Lorentz symmetry within the light-cone in space-time. The 4-vector ether velocity would receive a natural interpretation in the author's new theory of electrodynamics [see Abstr. 981 (1952)]. R. A. NEWING

530.12

749. Static spherically symmetric solutions in Einstein's unified field theory. W. B. BONNOR. *Proc. Roy. Soc. A,* **209,** 353–68 (*Nov.* 7, 1951).

A new static spherically symmetric solution of Einstein's unified field equations is derived. Certain boundary conditions are applied to this solution and to those already known, and the nature of the resulting fields is investigated. The only solution in the magnetic case corresponds to a magnetic pole without mass. In the electric case all the solutions correspond to continuous charge distributions, and the fields tend asymptotically to that of a point charge in classical theory. Several of the solutions are singular at an infinity of values of r, the radial co-ordinate, and in these the charge density is not of constant sign; but there are two solutions which have no singularities for finite values of r greater than $2m$ (where m is a constant associated with the mass), and in which the charge density has constant sign throughout the field. A.

530.12 : 523.2

750. On the problem of planetary motion according to the general theory of relativity. M. KOHLER. *Z. Phys.,* **130,** 139–43 (*No.* 2, 1951) *In German.*

It is noted that the Schwarzschild metric cannot be obtained directly from the principle of equivalence without the use of the field equations. R. A. NEWING

530.12 : 531.18

751. Conclusive considerations on special relativity. Q. MAJORANA. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **11,** 144–50 (*Sept.–Oct.,* 1951) *In Italian.*

Attempts to exhibit inconsistencies in the theory are continued. R. A. NEWING

530.12 : 531.31

752. On mechanical and relativistic conservation laws. A. WERFELI AND P. WILKER. *Z. Phys.,* **130,** 256–8 (*No.* 3, 1951) *In German.*

If the time t is regarded as an additional generalized co-ordinate and the equations of motion are derived from the variation principle $\delta\int\mathfrak{L}(q_i, q_i')d\tau = 0$, where τ is a parameter and $\mathfrak{L}$ is homogeneous of the first order in q_i' [see Abstr. 27 (1952)] it is shown that the conservation laws, and in particular $E = mc^2$, follow from the requirement that the above expression is invariant with respect to an infinitesimal transformation of the forms $\delta q_i = Q_i(q_1 \ldots q_n)\delta\varepsilon$. R. A. NEWING

530.12 : 531.51

753. Gravitation in kinematic relativity. A. G. WALKER. Letter in *Nature* [*Lond.*] **168,** 961–2 (*Dec.* 1, 1951).

Milne's theory can be modified by introducing a least action principle. A particular case whose approximate form is $\delta\int e^{-2\phi/c^2}(c^2 + V^2)dt = 0$ (A), where ϕ is the Newtonian potential, gives the same values of gravitational light deflection and of perihelion advance as in Einstein's theory, and, on reasonable assumptions, twice the value of the gravitational shift of spectral lines predicted by the general theory. (A) might be used to investigate systems too complicated for treatment by Einstein's field equations. R. A. NEWING

530.145 : 53

On the situation in theory of knowledge problems and the use of a three-valued logic in quantum theory. *See Abstr.* 746

530.145

754. Connection between particle models and field theories. I. The case spin 1/2. S. TANI. *Progr. Theor. Phys.,* **6,** 267–85 (*May–June,* 1951).

If, in Feynman–Dyson's rule of calculation, the contributions due to all closed loops of fermion line are neglected, the one-particle theory for the fermion may be treated. The transformation found by Pryce, by Foldy and Wouthuysen and also independently by the author allows of some explanation of fermion's behaviour when it is free. It is shown that also when the fermions are interacting with other fields, this transformation is suitable for a physical interpretation of the results. For example, the effects of the Zitterbewegung can be computed. Although it is profitable to work in the one-particle theory, the negative energy states must be interpreted in accordance with the positron theory; so the question of how far the one-particle theory should be modified to maintain the parallelism to the quantized field theory is discussed. A remark is added concerning the interpretation of charge operators, i.e. Dirac operators ρ's. Several results of the transformation are tabulated. A.

530.145

755. An adiabatic form of excitation theory in the problem of exchange effects of a particle with the quantum field. S. V. TYABLIKOV. *Zh. Eksper. Teor. Fiz.*, **21**, 377–88 (*No.* 3, 1951) *In Russian.*

Exchange terms in the Hamiltonian arise only in the 3rd approximation which allow transition between states and a finite lifetime. Application to an electron in an ionic crystal, and the ground state of a polaron.

J. JACOBS

530.145

756. A new variant of electron-positron pair theory. YA. I. FRENKEL. *Zh. Eksper. Teor. Fiz.*, **21**, 466–72 (*No.* 3, 1951) *In Russian.*

Vacuum polarization is explained by pair deformation in the external electric field. Other topics can be embraced by a more consequential quantum theory of pair mass, the possibility of coalition or splitting, translational mass (zero), relative mass ($2m_0$), quantization of relative motion, virtual pairs.

J. JACOBS

530.145

757. Note on many-fermion problems. T. NISHIYAMA. *Progr. Theor. Phys.*, **6**, 366–78 (*May–June*, 1951).

Non-equilibrium properties of the statistical operator are formulated in the scheme of second quantization. Some formulae of the so-called quantum hydrodynamics of Landau and those of Born and Green are examined. Further, Tomonaga's theory of one-dimensional sound quanta is studied, introducing spin degeneracies, and the three-dimensional problem discussed.

A.

530.145

758. A perturbation treatment of closed states in quantized field theories. B. TOUSCHEK. *Phil. Mag.*, **42**, 1178–84 (*Oct.*, 1951).

Discusses an iteration method by means of which it is possible to obtain approximate solutions for field theoretical problems involving bound states.

A.

530.145

759. On the interpretation of regularization in quantum electrodynamics. D. IVANENKO AND V. GRIGOREV. Letter in *Zh. Eksper. Teor. Fiz.*, **21**, 563–6 (*No.* 4, 1951) *In Russian.*

The equivalence of the "formal" regularization of Pauli and Villars and Pais's "physical" method of auxiliary fields to eliminate divergencies is illustrated.

W. J. SWIATECKI

530.145

760. On gauge invariance and equivalence theorems. Z. KOBA, N. MUGIBAYASHI AND S. NAKAI. *Progr. Theor. Phys.*, **6**, 322–41 (*May–June*, 1951).

The theorems are studied in the Feynman–Dyson formalism. The results may be of considerable use in reducing complicated calculations. When the Dyson diagram contains a closed loop, certain ambiguities appear as usual. From the standpoint that surface integrals in the momentum space should be estimated accurately, however, they are easily removed by a simple prescription. As an application of the method, the two-gamma-decay of a neutral meson is re-examined and entirely consistent results are obtained.

A.

530.145

761. On quantum electrodynamics. J. G. VALATIN. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **26**, 32 *pp.* (*No.* 13, 1951).

A formulation of quantum electrodynamics, without a supplementary condition, is given. Starting from the interaction representation, light waves are characterized by the 6-vector field satisfying the homogeneous Maxwell equations. In order to describe longitudinal interactions, an additional scalar field is introduced. Interactions with the electrons are defined by means of potentials given by these fields and related to a special time-like vector n_μ (or to a corresponding space-like surface). The scalar field variables can be eliminated by means of a canonical transformation which leads to a wave equation containing the transverse interaction energy and the Coulomb energy. In the Heisenberg representation, the potentials whose gauge is related to the special time-like vector n_μ do not satisfy the Lorentz condition. The field strength operators obey, however, the Maxwell equations. In calculating the S-matrix, the commutation rules of the potentials which depend on n_μ can be replaced by the simpler rules of the Fermi electrodynamics.

A.

530.145

762. Radiation corrections on the problem of electron scattering in an electromagnetic field. A. A. ABRIKOSOV AND J. M. KHALATNIKOV. *Zh. Eksper. Teor. Fiz.*, **21**, 429–35 (*No.* 3, 1951) *In Russian.*

A relativistic invariant method for calculating these for all exchange effects with emission under e^2/hc approximation. The method of excluding infinite irrelevant terms through restricting multiplicators applies to higher orders of excitation.

J. JACOBS

530.145

763. Effect of nucleon recoil on nuclear forces. G. ARAKI. *Progr. Theor. Phys.*, **6**, 379–93 (*May–June*, 1951).

The correction due to the nucleon recoil on nuclear forces is discussed according to the scalar and the pseudoscalar meson theory. The correction entirely changes the apparent form of two-nucleon interaction in case of the pseudoscalar theory. The singularity of the interaction becomes stronger in this case. However, the non-relativistic limit is the same as the well-known potential. The non-adiabatic correction includes the typical spin-orbit interaction in case of the scalar theory. The distinction of the present result from those which were obtained by other authors is discussed.

A.

530.145

764. On field theories with non-localized interaction. J. RAYSKI. *Phil. Mag.*, **42**, 1289–97 (*Nov.*, 1951).

It is shown that a method of direct quantization of field equations (completely avoiding the canonical formalism) is applicable to a wide class of fields with a non-local interaction. The extended source theory of Peierls and McManus is quantized and discussed. The S-matrix is computed by the method of C. N. Yang. A general rule for an immediate transcription of the traditional S-matrix elements into the new form

is given. Another type of a non-local interaction is discussed and it is shown that all the usual convergence difficulties may be easily avoided if we give up the strict localizability of charge, energy, etc., and if we abandon the postulate of gauge invariance of the second kind. This is acceptable since it is possible to guarantee the integral conservation laws without the continuity equations and to secure a vanishing photon rest mass by other devices, not necessarily by the formal gauge invariance. In the limit $\lambda \to 0$, where λ is a fundamental length, the discussed field theory goes over into the traditional quantum electrodynamics. A.

530.145

765. Divergent integrals in renormalizable field theories. A. SALAM. *Phys. Rev.*, **84**, 426–31 (*Nov.* 1, 1951).

The proofs of the renormalization of the theories of scalar and pseudoscalar mesons in scalar interaction with nucleons and with the electromagnetic field, given previously by the author [Abstr. 4104 (1951)], depended on a certain subtraction procedure. A general proof is here given that this subtraction procedure, when applied to a divergent integral in the S-matrix of a renormalizable field theory, does, in fact, lead to an absolutely convergent, covariant and unique remainder. A.

530.145

766. General Lorentz transformation of Dirac's wave function. V. TRKAL. *Bull. Int. Acad. Tchèque Sci.*, **50**, 407–25 (1949).

The transformation S of the Dirac equation $\psi = S\psi'$, $A\gamma = S^{-1}\gamma S$ corresponding to a Lorentz transformation $x' = Ax$, is found for arbitrary A and any representation of the γ_μ. G. J. KYNCH

530.145

767. Remarks on the pilot wave theory. L. DE BROGLIE. *C.R. Acad. Sci.* [*Paris*] **233**, 641–4 (*Sept.* 17, 1951) *In French.*

530.145

768. Geometrical introduction of the pilot wave in unitary affine theory. J.-P. VIGIER. *C.R. Acad. Sci.* [*Paris*] **233**, 1010–13 (*Oct.* 29, 1951) *In French.*

An attempt is made to provide a basis for de Broglie's discarded pilot wave theory (see preceding abstract) on the basis of Vigier's unitary theory [Abstr. 6028 (1951)]. The paper is followed by a critical note by de Broglie. R. A. NEWING

530.145

769. Note on the compound Dirac equation. D. C. PEASLEE. Letter in *Phys. Rev.*, **84**, 373–4 (*Oct.* 15, 1951).

The properties of an 8×8 irreducible representation are considered in detail. [See also Abstr. 5110 (1951)]. G. J. KYNCH

530.145

770. Group uniqueness in the irreducible volume character of events. B. T. DARLING AND M. LEIGHTON. Letter in *Phys. Rev.*, **84**, 598 (*Nov.* 1, 1951).

The apparently arbitrary procedure of averaging the difference equation which corresponds to Dirac's equation [see Abstr. 1595 (1951)] is justified. J. R. MADDOX

530.145

771. A generalisation of the nucleon and meson theory. V. VOTRUBA. *Bull. Int. Acad. Tchèque Sci.*, **50**, 173–90 (1949).

A formalism is developed in which π-mesons and nucleons (and leptons) possess states of "inner" excitation corresponding to particles of different rest masses (but same spin). The Kemmer and Dirac equations respectively are generalized by replacing the mass by a suitable Hermitian differential operator acting on an auxiliary variable and having only discrete positive eigenvalues. The meson-nucleon interaction is discussed. W. J. SWIATECKI

530.145

772. On the self-energy of the electron. V. P. SILIN. *Zh. Eksper. Teor. Fiz.*, **21**, 462–5 (*No.* 3, 1951) *In Russian.*

Inclusion of exchange effects of the electron with the meson field leads to results whose influence on the self-energy in the high energy region proves more important than that of the gravitation field. A correction of diverging self-energy expressions thus cannot lie in consideration of non-linear effects connected with gravitation. J. JACOBS

530.145

773. Boundary conditions and time-dependent states. M. MOSHINSKY. *Phys. Rev.*, **84**, 525–33 (*Nov.* 1, 1951).

In a previous paper [Abstr. 4688 (1951)] a phenomenological description of nuclear reactions by means of boundary conditions was introduced. These boundary conditions that connect the several stages of the reaction (initial particles, compound nucleus, etc.) apply to time-dependent, as well as to stationary states. It is possible to discuss then the time development of any state specified initially. A time-dependent description is obtained for the single-level S-wave scattering of two spinless particles, and for the process of disintegration of a compound particle. The only parameters on which this time-dependent description depends are the poles of the scattering matrix. The connection between the position of the poles of the scattering matrix in the complex plane, and the time-dependent behaviour of the scattering and disintegration processes, is discussed. The form of the transient scattered current is also obtained. The generalized Hankel transforms on which the present developments are based, will be shown in a following paper to be a consequence of the expansion theorems for states in Fock space. [See following abstract.] A.

530.145

774. Quantum mechanics in Fock space. M. MOSHINSKY. *Phys. Rev.*, **84**, 533–40 (*Nov.* 1, 1951).

A quantum-mechanical scheme in Fock space is developed that would describe interactions that take place through the formation of a compound particle. The discussion is restricted to a dynamical system representing a single-level scattering process. The state of this dynamical system can be found in two stages: initial particles and compound nucleus. The dynamical behaviour of this state is given in terms of a Hamiltonian (that has no classical analogue) which is derived from the boundary conditions satisfied by the state. The representation of the

dynamical variables, associated with the two stages of the state, is discussed, and a complete set of constants of motion of the dynamical system given. The expansion of an arbitrary Fock state in terms of the simultaneous eigenstates of this complete set of constants of motion, leads to the generalized Hankel transforms, used in a preceding article (preceding abstract) for the determination of the time dependent states for scattering and disintegration. In a representation in which the constants of motion are diagonal, the operator representing the relative kinetic energy of the two initial particles will be non-diagonal, particularly in the neighbourhood of the resonance energy. The unitary matrix connecting any initial Fock state with the corresponding state at time t is obtained, and with its help the time-dependent behaviour of the Heisenberg dynamical variables of the dynamical system can be derived. A.

530.145

775. On the formulation of quantum mechanics. I. Non-relativistic wave equations. B. Mrowka. *Z. Phys.*, **130**, 164–73 (*No.* 2, 1951) *In German.*

It is shown that a method of deriving the Schrödinger equation, due to Madelung [*Die mathematischen Hilfsmittel des Physikers* (1950)] can be generalized to derive more complicated equations. As examples, equations are derived for a particle in a magnetic field and the Pauli equation for a spinning particle. G. J. KYNCH

530.145

776. On minimal polynomials of matrices for relativistic wave equations. F. I. Fedorov. *Dokl. Akad. Nauk, SSSR*, **79**, 787–90 (*No.* 5, 1951) *In Russian.*

Bhabha's investigations omitted the important condition that states leading to a zero energy density are not permissible. In his theory the field satisfies a 4th order equation but from the shape of the minimal polynomial zero energy and charge result. J. JACOBS

530.145

777. Note on Schwinger's variational method. T. Kato. *Progr. Theor. Phys.*, **6**, 295–305 (*May–June*, 1951).

It is shown that one of the variational methods of Schwinger applied to the one-dimensional wave equation gives a lower bound of the absolute value of the scattering phase provided the potential is semi-definite and not too strong, a condition satisfied for potentials proposed for the neutron-proton scattering. Further, a simple modification of Schwinger's iteration procedure is proposed, which converges not only mathematically but also more rapidly than the original one. An upper bound of the absolute value of the phase is also shown to be obtained if the iteration method is carried out to the second approximation. Numerical examples are given in the case of a square-well potential, and very accurate upper and lower bounds of the phases are obtained. A.

530.145

778. Upper and lower bounds of scattering phases. T. Kato. *Progr. Theor. Phys.*, **6**, 394–407 (*May–June*, 1951).

A general method is developed for a rigorous estimation to upper and lower bounds of scattering phases in the variational methods applied to one-dimensional problems. It is also possible to estimate the mean error of the approximate wave function itself. An essential point in the method is the evaluation of mean square ε^2 of the left-hand side of the wave equation with respect to a weight function chosen appropriately. Also certain auxiliary constants α, β are needed, defined in connection with an eigenvalue problem associated with the wave equation. However, only a rough estimate is required of these quantities, and some general methods are given for their estimation. As an example, the scattering of slow electrons by H atoms is treated in the one-body approximation. It turns out that phases are determined rigorously with the possible errors of 10^{-3} or 10^{-4} by assuming a very simple trial function containing only two parameters, and that the approximate wave function is also exact within about 10^{-2}. A.

530.145

779. Theory of multipole radiations. P. R. Wallace. *Canad. J. Phys.*, **29**, 393–402 (*Sept.*, 1951).

A systematic analysis of the radiation from a given oscillating system of charges and currents is developed without any approximations. Using a simple vector identity, the vector potential is separated into irrotational and solenoidal parts. The field may be expressed in terms of the latter alone. A similar vector identity involving the operator $\boldsymbol{L} = \boldsymbol{r} \times$ grad (the rotation operator) permits the separation of the field into parts in which the radial components of the electric and magnetic field, respectively, vanish. The energy flux, energy density and angular momentum density may in each case be expressed in terms of the angular operators $\boldsymbol{L}, \boldsymbol{L}^2$. Expansion in the eigenfunctions of these operators, the spherical harmonics, corresponds to the separation into electric and magnetic multipoles of all orders. Introduction of "tensor spherical harmonics" enables us to exhibit these radiations in terms of natural multipoles (derivatives of $1/r$). All calculations are carried out without restriction as to size of radiating system relative to wavelength, in the induction as well as the radiation region. A.

530.145

780. A new family of approximate solutions for certain non-separable Schrödinger equations. Application to the ground state of helium. P. Pluvinage. *J. Phys. Radium*, **12**, 789–92 (*Oct.*, 1951) *In French.*

Good approximate wave-functions for two electron systems are found by modifying the kinetic energy term of the Schrödinger equation, to give an equation then solved exactly. Generalizations are discussed. Two-parameter wave-functions of this kind lead variationally to an ionization energy for He much closer to the experimental value than does the two-parameter trial function of Hylleraas. R. H. DALITZ

530.145

781. A theorem on the invariants formed from four Dirac wave-functions. Application to the cross-section for nucleon-nucleon scattering. L. Michel. *J. Phys. Radium*, **12**, 793–804 (*Oct.*, 1951) *In French.*

Many linearly independent tensors may be formed from four Dirac wave functions ψ_i. Permutation of the ψ_i leads to new tensors linearly dependent on the

former tensors. This theorem may be used, for example, to relate the S-matrix elements involving four fermions, as illustrated by a calculation for nucleon-nucleon scattering. The theorem is extended to the scalars and pseudoscalars formed from 6 ψ-functions. R. H. DALITZ

530.145

782. On the resolution of wave-equations of spin $\frac{1}{2}\hbar$ particles in interaction with a pseudoscalar radial potential. G. PETIAU. *J. Phys. Radium*, **12**, 810–16 (*Oct.*, 1951) *In French.*

530.162 : 536.7

783. Remark on the notion of the thermodynamic pressure. T. NISHIYAMA. Letter in *J. Chem. Phys.*, **19**, 1320 (*Oct.*, 1951).

Using the form $\Psi(x)$ for the wall potential instead of the form $\Psi(x/L)$ used by Ridell and Uhlenbeck [Abstr. 8506 (1950)], it is shown that the traces of commutators vanish identically for macroscopic observation. C. TURNER

530.162 : 536.7 : 532.73

Statistical thermodynamics of multicomponent systems. *See Abstr.* 814

530.162 : 539.11

784. A theory of cooperative phenomena. II. Equation of states for classical statistics. R. KIKUCHI. *J. Chem. Phys.*, **19**, 1230–41 (*Oct.*, 1951).

For Pt I, see Abstr. 5134 (1951). A method of obtaining the equation of state of a classical assembly through the solid, liquid and gas phases based on the order-disorder concept is explained. At first the method is illustrated on an imaginary two-dimensional model. Next, the general procedure to increase the number of interstitial sublattices to infinity is explained for a one-, two- and three-dimensional lattice. In the one-dimensional case, the present method proves to be identical with Gürsey's rigorous solution. An approximate treatment for the solid state is added. A.

530.162 : 548.0

785. Interaction between next-nearest neighbours in regular mixtures. E. A. GUGGENHEIM AND M. L. MCGLASHAN. *Trans Faraday Soc.*, **47**, 929–37 (*Sept.*, 1951).

The quasi-chemical treatment of regular mixtures has been extended for simple cubic and body-centred cubic lattices so as to include the interaction between next-nearest neighbours in a manner analogous to that used by Hill for monolayers on a simple square lattice. The effect of including such interaction on the thermodynamic properties of the mixture, calculated at a temperature equal to a given multiple or fraction of the critical temperature, is entirely negligible. A.

GENERAL MECHANICS . MECHANICS OF SOLIDS 531

531.224.4

786. Column behavior under conditions of compressive stress wave propagation. G. GERARD AND H. BECKER. Letter in *J. Appl. Phys.*, **22**, 1298 (*Oct.*, 1951).

Under impact loading, a bar can momentarily support a compressive stress far in excess of the static Euler load, and buckling then occurs in a critical length less than the actual length of the bar. J. G. OLDROYD

531.23 : 512.9

787. The antisymmetrical tensor of the moment of momentum. I. G. FIKHTENGOLTS. *Zh. Eksper. Teor. Fiz.*, **21**, 648–51 (*No.* 5, 1951) *In Russian.*

An invariant antisymmetrical tensor is considered, the spatial components of which represent in a second approximation the moments of momentum of some closed system of interacting bodies, whereas the space-time components are related to the integrals of the equations of movement of the centre of inertia and the integrals of the momentum of this system of bodies in the same approximation. The demonstration of the tensor character of the system considered and of its constancy in time is also carried out in the second approximation. B. F. KRAUS

531.259.2

788. The strength of temperature- and pressure-stressed hollow bodies with particular reference to very high pressure lamps. J. KERN. *Z. angew. Phys.*, **3**, 321–9 (*No.* 9, 1951) *In German.*

Formulae for the elastic forces which are exerted on the walls of a pressure- and temperature-strained cylindrical or spherical hollow body are calculated and discussed. The most favourable arrangement of pressure, heat, type of material and dimensions for maximum strength and breaking stress is calculated. The results, wherever applicable, are illustrated by graphs of values obtained experimentally from various high-pressure mercury lamps. S. WEINTROUB

531.261.35

789. On Dirichlet's derivation of the potential of an ellipsoid. H. BUCERIUS. *Astron. Nachr.*, **279**, 238–40 (*Aug.*, 1951) *In German.*

The Newtonian potential is expressed as an integral over the whole of space with the aid of a function F whose value is unity inside and zero outside the ellipsoid. F is expressed as a contour integral along the real axis indented at the origin in the complex z-plane. R. A. NEWING

531.35

790. The temperature barrier of high altitude, long distance missiles. II. Dynamics of missiles with an active thrust. G. A. CROCCO. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **11**, 3–10 (*July–Aug.*, 1951) *In Italian.*

For Pt I, see Abstr. 6049 (1951). Formulae, and their discussions, are presented for the calculation, together with a table of the numerical values, of the kinetic parameters of the elliptical trajectory of a missile moving under the reactive thrust of a propellant. The parameters are: η, central angle at the centre of the spherical earth; ψ, angle of elevation of the launching stage; λ, a ratio, namely $(V_0/V_E)^2$, where V_0 is the initial velocity, and $V_E = \sqrt{(2g_0R)}$; a, half the major axis of the elliptical trajectory;

R, radius of the earth; V_0, minimum initial velocity; X, the range; Z, maximal altitude of the missile; t, flying time: the last three columns give the coordinates of point D which is that locus on the trajectory where the active thrust of the jet comes to an end after the propellant has been spent. W. SUMMER

531.52

791. The fall of a particle through the atmosphere. G. LUCHAK. Letter in *Amer. J. Phys.*, **19**, 426 (*Oct.*, 1951).

In reply to a recent query [Abstr. 4123 (1951)] solutions, in closed form, are derived of the equations $\ddot{y} = \kappa\dot{y} \exp(\beta y)$ and $\ddot{y} = g - \kappa\dot{y}^2 \exp(\beta y)$. The first is solved by writing it in the form $d\dot{y}/dt = (d/dt)gt - \kappa\beta d \exp \beta y/dt$, and the second by inverting the dependent and independent variables, when it becomes $d^2t/dy^2 = \kappa \exp \beta y(dt/dy) - g(dt/dy)^3$.

J. S. G. THOMAS

531.52

792. Motion of a particle through a resisting medium of variable density. W. SQUIRE. Letter in *Amer. J. Phys.*, **19**, 426–7 (*Oct.*, 1951).

Alternative methods of solving the equations given in the preceding abstract are proposed, viz.: (i) by changing to dimensionless variables, and (ii) by reducing the equation to a first-order equation by the standard device $\dot{y} = p$. J. S. G. THOMAS

531.539

793. Dynamical stability of a pendulum whose point of suspension oscillates. P. L. KAPITSA. *Zh. Eksper. Teor. Fiz.*, **21**, 588–97 (*No.* 5, 1951) *In Russian.*

The movement of the pendulum is considered under the following conditions: (1) The amplitude a of the oscillations of the suspension is small compared with the length L of the pendulum; (2) the angular frequency of the oscillations of the suspension is high compared with that of the oscillations of the pendulum itself. It is shown that the oscillations of the suspension produce a moment of forces the value of which does not depend explicitly on time and the length of the pendulum, but is determined by the mass of the pendulum and by the square of the velocity of the suspension oscillations. This moment is called the vibration moment; it tends to orientate the rod of the pendulum in the axis of the oscillations of the suspension. The conditions of stability are found for the case where the C.G. of the pendulum is above the point of suspension. The value of the vibration moment is given for the case of anharmonic oscillations carried out by the suspension. An apparatus for demonstrating the vibration moment by its mechanical effects is described. Vertical oscillations of the suspension point, of a period smaller than that of the pendulum, will always accelerate the movement of clocks. The problem of the possibility of observing an orientating effect of a vibration moment on colloidal particles and molecules is discussed.

B. F. KRAUS

531.539

794. Pendulum excited by an alternating current. N. MINORSKY. *C.R. Acad. Sci.* [*Paris*] **233**, 728–9 (*Oct.* 1, 1951) *In French.*

Solutions are given of the non-linear differential equations of motion of a pendulum, part of which is of magnetic material, placed near a coil carrying a.c.

H. J. H. STARKS

MECHANICAL MEASUREMENTS 531.7

531.715.1 : 535.417

A photoelectric recording interferometer for measurement of dimensional changes. *See Abstr.* 930

531.717 : 538.566

795. The diffraction of electromagnetic waves on a dielectric cylinder as a method of thickness measurement for quartz threads. E. EBERHARDT. *Z. angew. Phys.*, **3**, 242–6 (*No.* 7, 1951) *In German.*

Theory is developed and experimental apparatus described for a comparative method of measurement of quartz threads. An experimentally obtained group of curves gives the relation between diffraction phenomenon and thread diameter. The accuracy and usefulness of the method is verified by data obtained with an electron microscope. The measuring accuracy of 7% is claimed for threads in the range 10–0·5 μ. Z. F. WOJNAR

531.767

796. The measurement of the velocities of bullets with a counter chronometer. R. M. DAVIES, J. D. OWEN AND D. H. TREVENA. *Brit. J. Appl. Phys.*, **2**, 270–1 (*Sept.*, 1951).

The measurement of the velocities of bullets, ranging between 700 and 1 400 ft/sec, presents difficulties when the experimental set-up precludes the use of a ballistic pendulum and when the rifle must be placed near the target to secure accuracy of aim. In the apparatus described, the velocities of bullets are measured by determining the time taken by the bullets to traverse a base-distance of the order of 20 cm; the time-interval is measured by a microsecond chronometer which is triggered at the beginning and the end of the interval by pulses produced when the bullets intercept two parallel pencils of light falling on two photocells. A.

531.768 : 621.317.39

797. Self-generating accelerometers. G. K. GUTTWEIN AND A. I. DRANETZ. *Electronics*, **24**, 120–3 (*Oct.*, 1951).

The voltage sensitivity of $BaTiO_3$ ceramic is lower than that of Rochelle salt, but its mechanical strength and dielectric constant are both higher and its conversion characteristic is hardly affected by temperature and humidity, so that it is a particularly useful material for transducers. Compression-type and bending-type accelerometers are described. One of the compression type has a sensitivity of 45 mV per "g," a capacitance of 1 500 pF and a natural frequency >6 000 c/s. Its temperature characteristic shows only small deviations from 20° to 100°C. With one of the bending type a sensitivity of about 200 mV per g was obtained, but the temperature characteristic was not as good as for the compression

type. Both types cover wide ranges of acceleration; a range from 600 g to 0·022 g can be obtained on a single instrument. Since the accelerometers are self-generating, their output does not depend on supply voltages. A. WILKINSON (R)

MECHANICS OF FLUIDS 532

532.517.2

798. On non-steady laminar flow of an incompressible viscous fluid in circular-cylindrical tubes. W. GERBES. *Z. angew. Phys.*, **3**, 267–71 (*No.* 7, 1951) *In German.*

On the assumption of rectilinear axially-symmetric flow, and an arbitrary variation of applied pressure with time, a general expression is obtained for the Laplace transform of the velocity in terms of that of the pressure-gradient. The velocity profiles at different times after the sudden application of a constant pressure, and at different times after its subsequent removal, are computed. The amplitude of oscillation in the velocity is calculated as a function of distance from the axis when the applied pressure varies sinusoidally at different frequencies. This amplitude decreases rapidly with increasing frequency, and the velocity is 90° out of phase with the pressure under all conditions. J. G. OLDROYD

532.525

799. The trajectories of heavy, solid particles in a two-dimensional jet of ideal fluid impinging normally upon a plate. C. N. DAVIES AND M. AYLWARD. *Proc. Phys. Soc.* [*Lond.*] *B*, **64**, 889–911 (*Oct.*, 1951).

An expression is derived for the flow field in a two-dimensional jet of ideal fluid impinging normally upon a plate situated at an arbitrary distance from a parallel-sided orifice. Numerical data are given when the orifice is at an infinite distance and in three other cases. In each example the trajectories of solid particles carried by the fluid are calculated by a stepwise method, and the conditions determining whether a particle will strike the plate or not are found. A.

532.528

800. Cavitation pressures and damage. S. KYROPOULOS. *Z. angew. Math. Phys.*, **2**, 406–10 (*Sept.*, 1951).

A possible explanation of the discrepancy between measured hydrodynamic pressures in cavitation experiments (900–1 600 kg/cm²) and the high pressures deduced from examination of the damaged polycrystalline surfaces (9 000–32 000 kg/cm²) is put forward. If the intercrystalline "cement" (largely impurities) has been eroded, the strength of the metal at the surface is effectively that of single crystals, and deformation occurs at much lower stresses than in the intact polycrystal under ordinary test conditions. There is some experimental confirmation, in that the resistance to cavitation damage is increased when the intercrystalline boundaries are reduced in thickness. J. G. OLDROYD

532.58 : 531.4

801. Frictional resistance of disks rotating in a liquid, and the integral equations applied to the problem. D. RIABOUCHINSKY. *C.R. Acad. Sci.* [*Paris*] **233**, 899–901 (*Oct.* 22, 1951) *In French.*

Experimental results relating to the frictional resistance experienced by disks rotating with constant angular velocity in a fluid, obtained by the author in 1914 [*J. Roy. Aero. Soc.*, **39**, 340, 377 (1935)] are compared, graphically, with results due to Schmidt and Kempf [*Vorträge, etc., Congrès d'Innsbruck, Berlin, p.* 169 (1924)], Hanocq [*Rev. Univ. Min.*, **18**, 8 (1928)], Barillon [*Rech. et Invent.*, **185**, 34 (1928)] and Theodorsen and Regier [*Rep. Nat. Adv. Comm. Aero.* [*Wash.*] **5**, 8 (*No.* 793, 1944)]. The author's integral equation is compared with that due to Kármán [*Vorträge, etc., Congrès d'Innsbruck, Berlin, p.* 153 (1924)] and applied to discuss briefly problems of the resistance of viscous fluids to the rotation of disks. J. S. G. THOMAS

532.582.8

802. Analysis of the swimming of microscopic organisms. G. TAYLOR. *Proc. Roy. Soc. A*, **209**, 447–61 (*Nov.* 22, 1951).

In the propulsion of microscopic bodies the stresses due to viscosity may be many thousands of times as great as those due to inertia. No case of self-propulsion in a viscous fluid due to purely viscous forces seems to have been discussed, however. The motion of a fluid near a sheet down which waves of lateral displacement are propagated is described. This analysis seems to explain how a propulsive tail can move a body through a viscous fluid without relying on reaction due to inertia. The work is extended to explore the reaction between the tails of two neighbouring small organisms with propulsive tails. It is found that if the waves down neighbouring tails are in phase very much less energy is dissipated in the fluid between them than when the waves are in opposite phase. It is also found that when the phase of the wave in one tail lags behind that in the other there is a strong reaction, due to the viscous stress in the fluid between them, which tends to force the two wave trains into phase. A.

532.592

803. Gravity waves in liquid of variable depth. M. ROSEAU. *C.R. Acad. Sci.* [*Paris*] **233**, 844–5 (*Oct.* 15, 1951) *In French.*

The velocity potential which corresponds to wave motion in a channel of variable depth is determined by making use of a conformal transformation. Two cases are covered by the solutions obtained: (i) the depth varies monotonically with distance, tending to a constant value at infinity in either direction; or (ii) the depth increases from zero along a sloping shore and tends to a constant value at infinity. J. G. OLDROYD

532.592

804. Solution of the functional equations occurring in the problem of gravity waves in liquid of variable depth. M. ROSEAU. *C.R. Acad. Sci.* [*Paris*] **233**, 916–17 (*Oct.* 22, 1951) *In French.*

The functional equations occurring in a previous paper by the author (see preceding abstract) are

discussed and applied to the solution of the problem of small two-dimensional harmonic motion of a liquid.
J. S. G. THOMAS

CAPILLARITY 532.6

532.612.4

805. The variation of surface tension near the critical point. Role of the densities of the liquid and of the saturated vapour. C. BACHAUD. Letter in *J. Phys. Radium*, **12**, 825–6 (*Oct.*, 1951) *In French.*

An investigation of the behaviour of the function $\sigma/(n_L - n_V)^3$ near the critical temperature (σ = surface tension, n_L = molecular density of the liquid in equilibrium with the vapour of density n_V). T. C. TOYE

532.694.1 : 542.48

806. On the fractionating of complex liquids by foaming. R. DUBRISAY. *C.R. Acad. Sci.* [*Paris*] **233**, 781–3 (*Oct.* 8, 1951) *In French.*

A discussion of methods for the fractionation of liquids by foaming. T. C. TOYE

MOLECULAR THEORY OF LIQUIDS 532.7

532.7 : 532.61

807. On the theory of holes in liquids. Calculation of the heat of fusion. Calculation of the variation in volume on fusion. G. SUTRA. *C.R. Acad. Sci.* [*Paris*] **233**, 1027–9 (*Oct.* 29); 1186–8 (*Nov.* 12, 1951) *In French.*

A new formula is put forward for the calculation of the heat of fusion based on the hole theory. See also Abstr. 8557 (1951). T. C. TOYE

532.712

808. Osmotic pressure and viscosity of nitro-celluloses with homologous polymers. A. MÜNSTER. *Z. Phys. Chem.*, **197**, 17–38 (*No.* 1–2, 1951) *In German.*

The measurements of osmotic pressure and viscosity of acetone solutions of polymer-homologous nitro-celluloses from cotton have shown that the reduced osmotic pressure has a strictly linear relationship to concentration in the interval 0·15–1 g/litre, and that the slope of the $\pi/c(c)$ curves slightly increases as the molecular weight decreases—both findings in agreement with the theory. As regards the intrinsic-viscosity/molecular-weight relationship, it has been found that the Staudinger formula is inapplicable to nitro-cellulose in acetone. The evaluation of measurements on the basis of new theories shows that the nitro-cellulose chains in acetone have a considerable internal mobility. F. LACHMAN

532.72

809. The diffusion of some organic substances in polystyrene. G. S. PARK. *Trans Faraday Soc.*, **47**, 1007–1013 (*Sept.*, 1951).

Sorption rates have been measured for ethylene dichloride, ethylidene dichloride, propyl chloride, butyl chloride, methylene iodide, benzene and trichlorethylene by polystyrene sheet at several vapour pressures. Diffusion coefficient relationships are discussed. A.

532.72

810. Absorption by simultaneous diffusion and chemical reaction into particles of various shapes and into falling drops. P. V. DANCKWERTS. *Trans Faraday Soc.*, **47**, 1014–23 (*Sept.*, 1951).

A substance diffuses into an absorbent in which it is destroyed by a first-order process. A method is given by which expressions for the transient concentration-distribution and rate of absorption can be obtained by transformation of expressions for diffusion without reaction. For absorbent particles of simple shapes the latter correspond to solutions of well-known problems in heat-conduction and can be found in textbooks. The method is illustrated by application to the sphere, parallelepiped, cylinder and semi-infinite absorbent, and also to a liquid drop moving through another liquid. Steady-state solutions are also discussed. A.

532.72

811. The passage of water soluble substances through a lipid barrier. W. KOPACZEWSKI. *C.R. Acad. Sci.* [*Paris*] **233**, 956–8 (*Oct.* 22, 1951) *In French.*

Narrow strips of filter paper soaked with a fatty substance are arranged so that the ends dip into an aqueous solution of colouring matter. The colouring matter can, in certain cases, penetrate the lipid barrier, and rise up the paper. Fatty substances vary greatly in the ease with which they are permeable by water soluble substances and the speed of penetration can be altered by such factors as surface tension, viscosity, electric charge. The implication to the permeability of cell membranes is pointed out.
J. IBALL

532.72, 533.15, 539.217

812. A unified picture of diffusion. J. D. BABBITT. *Canad. J. Phys.*, **29**, 427–36 (*Sept.*, 1951).

It is shown that if the equation $\partial p/\partial x - A_x = 0$, where p is a pressure function and A_x a resistive or frictional force, is taken as the fundamental dynamical equation, it is possible to explain diffusion in solutions, in solid solutions and in an adsorbing solid as well as the interdiffusion of two gases. In diffusion in both liquid and solid solutions the pressure function is the osmotic pressure; in diffusion of adsorbed gases the pressure function is the spreading pressure of the adsorbed layer. Since these pressure functions are thermodynamic properties of the system the pressure gradient is independent of the physical picture assumed for the system. To evaluate A_x, however, it is necessary to assume a specific physical mechanism for the movement of the molecules. A.

532.73

813. The term "regular solution." J. H. HILDEBRAND. Letter in *Nature* [*Lond.*] **168**, 868 (*Nov.* 17, 1951).

An accurate definition is suggested of the term "regular solution" invented in 1927 by the author.
F. LACHMAN

532.73 : 536.7 : 530.162

814. The statistical thermodynamics of multi-component systems. W. B. BROWN AND H. C. LONGUET-HIGGINS. *Proc. Roy. Soc. A*, **209**, 416–18 (*Nov.* 7, 1951).

The second-order theory of conformed solutions is discussed. A.

532.74 : 534.23

815. On the propagation of ultrasonic waves in acetic acid. E. FREEDMAN. Letter in *J. Chem. Phys.*, **19**, 1318 (*Oct.*, 1951).

The absorption coefficient per wavelength is quoted as derived by Bauer's [Abstr. 1764 (1949)] method, but with the assumption that a second-order rate equation describes the formation of the dimer. Comparison of the theory with Lamb and Pinkerton's [Abstr. 802 (1950)] data is given. J. E. CAFFYN

532.78

816. Contributions to the theory of nucleation. O. KNACKE. *Z. Phys.*, **130**, 259–67 (*No.* 3, 1951) *In German.*

Starting from the metastable distribution of small nuclei (Unterkeime), the nucleation frequency for homogeneous nucleation is found to be $J = w_k n_1 e^{-A_k/kT}$, where w_k is the frequency of transition of a molecule from the mother phase into the nucleus, n_1 the number of molecules in the mother phase and A_k the nucleation work. In experiments a "starting time," required for the establishment of the metastable distribution but not yet taken into account by the theory, elapses before the nucleation begins. In an assembly of analogous systems nucleation follows the law of radioactive decay. The maximum supersaturation in the case of an ideal crystal is *c.* 50%, compared with, at most, 1% in real crystals. The surface diffusion causes only a slight reduction in the critical supersaturation but a considerable increase of the nucleation frequency at supersaturations higher than critical. F. LACHMAN

MECHANICS OF GASES 533

533.1

817. The establishment of the pressure régime in a pipe conveying gas to a great distance. G. RIBAUD. *C.R. Acad. Sci.* [*Paris*] **233**, 1153–6 (*Nov.* 12, 1951) *In French.*

Gas being introduced at one end of a very long, empty pipe, it is required to derive an expression for the pressure, P, in the pipe (of diameter D) at a distance (x) from that end at any subsequent time (t). Q denoting the volume of gas present at distance x from the end at time t, the equations to be solved are $\partial P^2/\partial x = -AQ^2/D^5$, and the equation of continuity, $\partial P/\partial t = -B(\partial Q/\partial x)/D^2$ in which A and B are constants. Solution of these equations, under "boundary conditions," yields $P = AQ_0D^{-5/2}t^{1/3}(xt^{-2/3})$ where Q_0 is the volume of gas supplied at the end of the pipe, $X = 0$, at $t = 0$. The solution, which is applicable only to the turbulent régime, has been confirmed by results obtained in two feeder pipes of different diameters in a gas supply system. J. S. G. THOMAS

533.15

818. Molecular streaming through composite tube systems. W. HARRIES. *Z. angew. Phys.*, **3**, 296–300 (*No.* 8, 1951) *In German.*

The author abandons the concept of tube resistance, and treats the problem from the viewpoint of statistical probability. L. G. CARPENTER

533.15 : 541.183

819. On the diffusion of adsorbed gases through solids. J. D. BABBITT. *Canad. J. Phys.*, **29**, 437–46 (*Sept.*, 1951).

The equations for the diffusion of an adsorbed gas through a solid are developed on the assumption that the resistive force is directly proportional to the number of molecules adsorbed, that is, that the resistive force per molecule is constant. The equations are compared with experiment and also with the equations developed in an earlier paper [Abstr. 123 (1951)] where the assumption was made that the resistive force per molecule is inversely proportional to the number of molecules adsorbed. The equations developed here are not as satisfactory as those developed earlier and it is pointed out that this is a consequence of the fact that heats of adsorption have been found experimentally to decrease as the amount of adsorbed gas increases. A.

533.21 : 536.7

820. Isotherms and thermodynamical functions of three hydrogen-nitrogen-ammonia mixtures between 0° and 150°C and pressures up to 300 atmospheres. A. MICHELS, T. WASSENAAR, G. J. WOLKERS, W. DE GRAAFF AND P. LOUWERSE. *Appl. Sci. Res.*, **A3**, 1–10 (*No.* 1, 1951).

Compressibility isotherms of three hydrogen-nitrogen-ammonia mixtures have been measured between 0° and 150°C up to densities of 180 Amagat (pressures up to 300 atmospheres). From these data thermodynamical functions have been calculated; they are given as function of temperature and pressure. A.

533.27 : 536.752

821. The adiabatic coefficient of dissociating combustion gases in adiabatic-isentropic expansion. G. KLOBE. *Z. angew. Math. Phys.*, **2**, 394–402 (*No.* 5, 1951) *In German.*

It is shown that the value of k in the relation $pv^k = \text{const}$ for isentropic expansion of a gas mixture whose equation of state is $pv = (\Sigma n)RT$ (Σn, the sum of the molecular concentrations of the constituents of the mixture, being a known function of p and T) is not equal to the ratio of the specific heats, γ, but is given by $\gamma|(d \ln p/d \ln v)|_T$. As this formula is not convenient for computation, an alternative numerical procedure is described which is applicable to mixtures in water-gas equilibrium. Diagrams are appended which facilitate the calculation of the flame-temperature of approx. stoichiometric mixtures as a function of pressure and of the calorific value of the fuel. A. SCHOFIELD

533.275.01

822. On the formula for the aspiration psychrometer. C. MÜLLER-COSNA AND H. MAIER-LEIBNITZ. *Z. angew. Phys.*, **3**, 343–5 (*No.* 9, 1951).

A new formula relating wet bulb depression to vapour pressure is deduced by considering the dynamic heat conduction and water vapour diffusion at the wet bulb. There is a 6% difference from the Sprung formula, but results obtained with a thermoelectric psychrometer, which is described, show better agreement with the new formula. E. H. DOCK

533.5

823. Modern vacuum pumps. D. R. GODDARD. *J. Sci. Instrum., Suppl. No.* 1 [*Vacuum Physics*] 1–7 (1951).

The two distinct classes of pump, the mechanical and the vapour pump, are discussed in a general rather than a detailed theoretical manner with a view to examining the factors influencing performance and the more important design features. The different types of rotary pump are compared and their performance examined in relation to the requirements of capacity, ultimate pressure and the pumping of condensable vapours. The mechanism of vapour pumps is discussed in relation to the design of ejectors and diffusion-condensation pumps. A comparison of oil and mercury pumps is made and the requirements of capacity, ultimate pressure and backing pressure characteristics discussed. A.

533.5

824. The design of industrial vacuum systems. T. S. MILLEN. *J. Sci. Instrum., Suppl. No.* 1 [*Vacuum Physics*] 7–10 (1951).

After outlining the laws governing the flow of gases at low pressures and their relation to the performance of individual components, the author proceeds to discuss a trial design. The information required is discussed and the factors which influence the final choice of components are dealt with in some detail with special reference to the basic features and the influence of operating methods and conditions on the design. Systems of control are described and an indication is given of the methods by which automatic protection can be applied. A.

533.5

825. Review of vacuum gauges. W. STECKELMACHER. *J. Sci. Instrum., Suppl. No.* 1 [*Vacuum Physics*] 10–19 (1951).

A short account is given of methods for measuring pressures below 10 mm of mercury and of the limitations of conventional gauges for accurate measurement. The applications of gauges to industrial processes and their use as protective devices are discussed. A.

533.5

826. General principles of leak detection. J. BLEARS AND J. H. LECK. *J. Sci. Instrum., Suppl. No.* 1 [*Vacuum Physics*] 20–8 (1951).

The techniques of leak detection are reviewed, special emphasis being placed on methods for obtaining high sensitivity with simple apparatus. A theoretical analysis of the gas flow problem is supplemented by experimental results obtained with a system using two diffusion pumps in cascade. The importance of using constrictions and correctly positioning the gauge is stressed, and the losses of sensitivity due to virtual leaks, leaks in series and by-pass methods are considered. The relative sensitivities of different leak detection methods are tabulated. A.

533.5

827. A cold-cathode mass spectrometer leak detector. C. J. MILNER. *J. Sci. Instrum., Suppl. No.* 1 [*Vacuum Physics*] 29–36 (1951).

A cold-cathode spectrometer has the advantages of robustness, long life and avoidance of refrigerated traps. In the instrument described, the use of an a.c. amplifier for the ion current, in conjunction with velocity modulation of the ion beam, greatly reduces background effects. Leaks smaller than 10^{-5} μl/sec can be detected in vessels whose gas output is up to 1 μl/sec. Gas outputs up to 100 μl/sec can be handled by the instrument's pumps, with proportional increases in detection limit. Various features of the design and characteristics are discussed. Some observations are made with regard to the applications and field of use of the instrument. A.

533.5

828. Application of the mass spectrometer to high vacuum problems. J. BLEARS. *J. Sci. Instrum., Suppl. No.* 1 [*Vacuum Physics*] 36–42 (1951).

The potentialities of the mass spectrometer in studies of high vacuum problems are illustrated by descriptions of analyses of residual gases during initial evacuation, during baking and at the ultimate pressure. Surface exchange and synthesis products are considered, and it is concluded that mass spectrometry can solve many problems where it is difficult to distinguish between extraneous effects and real changes of pressure, or gas composition. A.

533.5

829. Large-scale vacuum dehydration. D. R. GODDARD. *J. Sci. Instrum., Suppl. No.* 1 [*Vacuum Physics*] 43–6 (1951).

The use of pressures in the micron region in vacuum dehydration has recently extended the field of application of this process. The freeze-drying process for the large-scale preparation of biological substances and the drying from the liquid state of less heat-sensitive materials are illustrations of industrial importance. A.

533.5 : 536.422

Freeze-drying—vacuum sublimation. *See Abstr.* 954

533.5 : 537.534

830. The vacuum system of the Birmingham proton synchrotron. L. RIDDIFORD. *J. Sci. Instrum., Suppl. No.* 1 [*Vacuum Physics*] 47–58 (1951).

The theoretical requirements of the vacuum system of the Birmingham $1{\cdot}3\times10^9$ eV proton synchrotron are considered, and the design and development work performed to satisfy these requirements described in some detail. To be certain that no difficulty in operating the accelerator will be encountered because of gas scattering of the proton beam by the remaining molecules, it is necessary to produce a vacuum of about 1×10^{-6} mm of mercury air equivalent in the

extended vacuum chamber. The vacuum chamber has to be in the form of a hollow ring about 30 ft in dia., with a rectangular cross-section 40×10 cm. Because of the high degree of vacuum required, and the fact that a heavy hydrocarbon molecule "gas-scatters" very much more than does an air molecule, the problem of the ultimate vacua of oil diffusion pumps is of the greatest importance. An attempt is made to throw some light on this difficult subject. A.

533.5 : 539.215.7

Melting and sintering of metals in vacuo. *See Abstr.* 1228

533.5 : 539.234

Recent advances in vacuum coating plant and techniques. *See Abstr.* 1231

533.581

831. Leaks in vacuum liquid-air traps. L. Riddiford and R. F. Coe. Letter in *J. Sci. Instrum.*, **28**, 352–3 (*Oct.*, 1951).

Stainless steel liquid-air traps show leakages which are due to minute holes and not to refrigeration stress. The allowable leak-rate in these traps is of the order of 1% of the leak-rate in the rest of the vacuum equipment. W. SUMMER

533.6.01 : 536.46

832. Calculation of the aerodynamic field of stabilized flames. J. Fabri, R. Siestrunck and C. Fouré. *C.R. Acad. Sci.* [*Paris*] **233**, 1263–5 (*Nov.* 19, 1951) *In French.*

The aerodynamic field of a flame, initiated and stabilized by a body of negligible dimensions, in a homogeneous, gaseous, combustible mixture contained in a cylindrical tube, and moving with uniform velocity at an infinite distance up stream, is discussed mathematically under the assumptions that (1) the field is slightly inclined to the axis of the pipe, and (2) that viscosity, thermal conductivity and variation with temperature of specific heats of the gases can be neglected, is discussed mathematically. The resulting field is similar to that derived by Tsien for the case in which compressibility is negligible [Abstr. 6926 (1951)]. A method of solution for this case, employing a method of convergent successive approximations, is briefly referred to. J. S. G. THOMAS

533.6.011.311

833. Note on the boundary layer on a rotating sphere. L. Howarth. *Phil. Mag.*, **42**, 1308–15 (*Nov.*, 1951).

The solution of the boundary layer equations for the flow associated with a rotating sphere is considered and an approximate solution is obtained. The solution on either hemisphere is thought to be valid up to the immediate vicinity of the equator where it is invalidated by the interaction with the flow from the other hemisphere. A short appendix gives the flow due to a semi-infinite cylinder rotating in a uniform stream. A.

533.6.011.311

834. Numerical integration of the boundary-layer equation. D. Meksyn. *Proc. Roy. Soc. A*, **209**, 375–9 (*Nov.* 7, 1951).

The boundary-layer equation is integrated step by step and by successive approximations, and applied to Schubauer's measurements of flow past an elliptic cylinder; the results obtained are in satisfactory agreement with the measurements. A.

533.6.011.5

835. Application of Lighthill's method to a plane supersonic flow. J. Legras. *C.R. Acad. Sci.* [*Paris*] **233**, 1005–8 (*Oct.* 29, 1951) *In French.*

The method of analysis developed by Lighthill [see Abstr. 2249 (1950)] and by Whitham [*Proc. Roy. Soc. A*, **201**, 89–108 (*March* 7, 1950)] is applied to determine, more especially, the shock waves produced by an obstacle placed in a plane supersonic flow stream, both in the neighbourhood of, and remote from, the object. A first approximation, valid throughout the whole stream, is derived. J. S. G. THOMAS

533.6.011.5

836. Wind tunnel test of a wing of finite aspect ratio of symmetrical double wedge section at supersonic speeds. P. L. Orman, R. S. Rae and G. N. Ward. *Proc. Roy. Soc. A*, **209**, 309–24 (*Nov.* 7, 1951).

Tests have been carried out on a wing of symmetrical double wedge or rhombus section, 10% thickness, for aspect ratios 1·5, 1·25, 1·0 and 0·75 at Mach numbers 1·3, 1·5 and 2·3. The wing was attached to the tunnel wall and the results include the effect of the boundary layer on this wall. Lift, wave drag and normal force coefficients and the co-ordinates of the centre of pressure are given. A comparison with theory shows as good an agreement as can be expected. A.

533.6.013

837. The aerodynamic forces on an oscillating aerofoil between two parallel walls. R. Timman. *Appl. Sci. Res.*, **A3**, 31–57 (*No.* 1, 1951).

Exact formulae are given for the aerodynamic forces on an oscillating aerofoil between two parallel walls. The solution is based upon Green's function for the configuration, formed by the aerofoil and the walls, which can be expressed in elliptic functions. A.

533.6.013.22

838. The diffusion of heat spots in isotropic turbulence. A. A. Townsend. *Proc. Roy. Soc. A*, **209**, 418–30 (*Nov.* 7, 1951).

A technique has been developed for the production of small heat spots in the turbulent flow behind biplane square-mesh grids, and their distribution downstream of the point of production has been studied using a Wollaston wire-resistance thermometer of response time 0·0002 sec. The transverse spatial distribution function is found to be a Gaussian error function (within the limits of experimental error) at all distances, in agreement with previous results on the temperature wake of a long thin wire. It is possible to determine a mean peak temperature of the spots by measuring the probability that the production of a spot will subsequently raise the temperature at the detector by more than a threshold value as a function of that value. The mean peak temperature is found to decrease with distance downstream more rapidly in turbulent flow than in non-turbulent flow, the observed temperatures being in quantitative agreement with those computed by assuming a spatially uniform rate-of-strain over the volume occupied by the spot. Since the extended spot is too

large for this assumption to be literally true, it is concluded that, in the final form, the heat is probably concentrated in a contorted thin layer, and that, following the spot, the shear pattern remains nearly constant in type, decaying aperiodically with the turbulence. A.

533.6.08

839. Pitot tube, cylindrical probe and two-finger probe as devices for measuring kinetic pressure. H. S. STEFANIAK. *Z. angew. Phys.*, **3**, 181–5 (*No.* 5, 1951) *In German.*

By taking into account the way in which the pressure reading varies with the orientation of a Pitot tube in relation to the stream, pressures and directions of fluid flow can be deduced without the need for measuring the static pressure directly. As a consequence, the size of the instrument can be reduced, and velocity profiles can be explored with negligible disturbance to the flow. The "two-finger probe," comprising two Pitot tubes at right angles in a plane containing (approximately) the velocity vector, permits more rapid measurements than other devices: a linear relation holds between kinetic pressure and inclination of the tubes to the velocity vector up to about 20° from the symmetrical position, and the instrument is not sensitive to a small flow component across the plane of the tubes. Flow past an elliptic cylinder has been mapped out with this instrument.

J. G. OLDROYD

MOLECULAR THEORY OF GASES 533.7

533.7

840. A note on mass motion of a gas. D. S. KOTHARI AND L. S. KOTHARI. *Indian J. Phys.*, **25**, 305–8 (*July*, 1951).

The method of collisions has been applied to Fermi–Dirac and Bose–Einstein statistics to establish that the total kinetic energy of a gas is compounded of two independent terms, one being the energy of mass motion and the other that of molecular motion. A.

533.7 : 536.44

841. Theory of the correlation of density fluctuations in real gases. H. MEISSNER. *Z. Phys.*, **130**, 202–13 (*No.* 2, 1951) *In German.*

The "critical opalescence" phenomenon caused by the formation of molecular swarms is explained by taking into account the mutual interaction of density fluctuations using correlation functions. F. LACHMAN

533.7 : 536.7

842. Thermodynamic behaviour of a gaseous assembly of point-molecules assuming association. M. DUTTA. *Indian J. Phys.*, **25**, 317–28 (*July*, 1951).

In nature, for many gases, viz. sulphur vapour, water vapour, etc., there is decisive evidence of associations of molecules, yielding higher polymers. Here, on starting from some well-known results previously obtained by the Darwin–Fowler method, various properties of the assembly, viz. isothermal and adiabatic compressibilities, coefficient of expansion, etc., have been investigated and have been expressed in terms of degree of associations such that an estimation can also be made from measurements of these quantities. Many of those properties have remarkable deviations from those of ideal gases in a direction opposite to that of usual real gases. These peculiarities have also been justified qualitatively from Le Chatelier and Braun's principle. A.

533.75

843. On the form of the curves $[1/(\partial \log p/\partial v)]_T = f(v)$. R. LOISY. *J. Phys. Radium*, **12**, 735–9 (*July–Aug.*, 1951) *In French.*

The curves are drawn and discussed for a large number of fluids. T. C. TOYE

533.75

844. Calculation of the number of the van der Waals' complexes in a vapour. R. B. SEGAL AND YA. I. FRENKEL. *Zh. Eksper. Teor. Fiz.*, **21**, 642–7 (*No.* 5, 1951) *In Russian.*

The number of the multimolecular complexes has been computed for vapours (H_2O, A, HCl, Ca) near their saturation points. It depends to a large extent on the proximity of saturation and on the temperature, reaching substantial values near the saturation point. Water vapour ($p = 1$ atm., $T = 380°$[K]) contains 10^{18} two-molecule complexes. F. LACHMAN

VIBRATIONS . ACOUSTICS 534

534.113

845. The calculation of stress and strain waves in long rods by a method common in electrical communication technology. K. SIMONYI. *Acta Tech. Hungarica*, **1**, 319–63 (*No.* 3, 1951) *In German.*

Problems of mechanical vibrations are solved by making use of the analogy between the differential equations governing mechanical and electrical oscillating systems in which mechanical displacement corresponds to electric charge, mass to inductance, frictional coefficient to electrical resistance, and elastic modulus to the reciprocal of capacity. The reflection of longitudinal waves in rods, at the boundary surfaces separating different materials and at faults in the material, is considered. The natural frequencies of vibration are calculated for systems of rods joined together and for a rod tapering in the form of a cone; this leads to a discussion of the vibrations occurring during forging. J. G. OLDROYD

534.13

846. Longitudinal modes of elastic waves in isotropic cylinders and slabs. A. N. HOLDEN. *Bell Syst. Tech. J.*, **30**, 956–69 (*Oct.* 1, 1951).

The general properties of the longitudinal modes in cylinders and slabs are developed with the aid of the close formal analogy between the dispersion equations for the two cases. A.

534.21 : 538.65

Effect of a magnetic field on the propagation of sound waves in a ferromagnetic material. *See Abstr.* 1138

534.23 : 532.74

Propagation of ultrasonic waves in acetic acid. *See Abstr.* 815

534.26

847. Diffraction of sound waves at uneven surfaces. L. M. BREKHOVSKIKH. *Dokl. Akad. Nauk, SSSR*, **79**, 585–8 (*No.* 4, 1951) *In Russian.*

Starting from the assumption, analogous to that of Kirchhoff in the usual theory of diffraction, that the sum of incident and reflected plane waves at each point of the limit of the sound field will be a sufficient basis for calculation of ϕ and $\delta\phi/\delta n$, where n is the interior normal to the surfaces, at such limit, the author goes on to show, by a series of mathematical deductions, that, if a shallow, regular ripple of a wavelength less than that of the sound-wave occurs at any considerable inequality on plane surfaces, supplementary diffusion of sound will ensue. It is added that the theory can be generalized to apply equally to the case of electromagnetic waves. J. CLEUGH

534.26

848. The formal connection between the atomistic theory of sound scattering in liquids and problems of electrotechnics, especially four-terminal-network theory. K. ALTENBURG. *Frequenz*, **5**, 285–9 (*Oct.*, 1951) *In German.*

On the basis of the mathematical similarity of the equations of mechanical and electrical vibrating systems, results for the spread of electrical waves along a 4-pole chain can be applied to acoustic waves. By attributing a 4-pole to each molecule the velocity of sound in liquids and mixtures of regular, statistical distributions, is calculated. In liquids a modulation and demodulation of ultrasonic waves must occur, and an amplitude dependence for the sound velocity is predicted. Ultrasonic absorption, especially by heat conduction, is interpreted as frequency transformation of sound- into heat-waves. J. JACOBS

534.32

849. Predominantly subharmonic oscillations. C. A. LUDEKE. *J. Appl. Phys.*, **22**, 1321–6 (*Nov.*, 1951).

An electromechanical analogue previously reported [Abstr. 2 (1950)] is used to investigate the phenomena of subharmonic oscillations. Special consideration is given to the case in which the subharmonic "predominates," i.e. in which the amplitude of the Fourier component having the subharmonic frequency is greater than the amplitude of the fundamental. An investigation is then made of the possible transitions between subharmonics of different orders. A.

534.321.9

850. Ultrasonic research at King's College, University of Durham. J. F. W. BELL. *Nuovo Cim.*, **7**, 92–6 (*Suppl. No.* 2, 1950).

Corrections are being studied for application to interferometric measurements on gases where the source of vibration is not infinite in extent, the problem being studied by treating the interferometer as a cavity resonator. The absorption and variation of velocity of ultrasonic waves in narrow tubes are also being studied. A. C. WHIFFIN

534.372

851. Damping of vibrating bodies by friction with the surrounding medium. K. VOELZ. *Z. angew. Phys.*, **3**, 185–7 (*No.* 5, 1951) *In German.*

Formulae are given for calculating approx. the log. dec. of the longitudinal, flexural and torsional vibrations of a cylinder damped by a surrounding medium of known density and kinematic viscosity [see also Abstr. 6813 (1951)]. H. J. H. STARKS

534.39 : 613.644

852. Ultrasonic spectra emitted by aeroplane propellors and indications of the physiological effects produced by certain of them. P. GROGNOT. *Ann. Télécomnun.*, **6**, 341–4 (*Nov.*, 1951) *In French.*

Analysis indicates that frequencies between about 22 kc/s and 25 kc/s are most common with intensities between about 80 and 115 db above the reference level. The fraction absorbed by materials surrounding the cockpit has also been studied. Tests with human subjects show that exposure of the body, particularly the head, without protection, produces reaction in the blood. The results of tests on animals killed by exposure to such ultrasonics are given.

G. F. HODSMAN

534.422

853. A new improved model of ultrasonic siren. L. PIMONOW. *Ann. Télécommun.*, **6**, 337–41 (*Nov.*, 1951) *In French.*

Constructional details are given, together with the design of a suitable intensity meter. Experiments with cotton, wood, insects and mice subjected to sound fields of about 160 db at 26 kc/s are described, photographs being given showing the results obtained.

G. F. HODSMAN

534.83

854. American standard test code for apparatus noise measurement. *Amer. Stand. No. Z24·7*, 11 *pp.* (1950).

534.843

855. Pulse methods in the acoustic analysis of rooms. J. MOIR. *J. Soc. Mot. Pict. Televis. Engrs*, **57**, 147–55 (*Aug.*, 1951).

Experience has indicated that the sound quality of cinema theatres was not related to the overall frequency characteristic or the reverberation time. A pulse technique is described which gives a picture of the direct and reverberant sound at any location. The value of the reverberation-time concept is questioned and recommendations are made for optimum design, based on the results of the pulse analysis. G. F. HODSMAN

OPTICS . RADIATION . SPECTRA 535

535.071–15

856. Visual researches in the near infra-red spectrum. A. VAŠKO. *Bull. Int. Acad. Tchèque Sci.*, **50**, 263–9 (1949) *In French.*

An infrared image convertor with Ag–O–Cs cathode with a spectrometer is used for visual and photographic observations to 15 300 Å. D. H. WHIFFEN

535.24

857. Direct-reading light flux meter. G. GAGLIARDI AND A. T. WILLIAMS. *J. Soc. Mot. Pict. Televis. Engrs*, **57**, 28–32 (*July*, 1951).

Describes a method for measuring the average illumination on a cinema screen, or the illumination

at any particular position on the screen, by means of a photo-electric instrument placed immediately in front of the projection lens. For measurement of the illumination at any area, an opaque screen with a hole at the appropriate position is placed at the film gate: to obtain the average illumination, a screen with a number of holes, suitably disposed and of the correct relative sizes to give proper weight to each area, is used. The instrument itself is a form of flux integrator. J. W. T. WALSH

535.24 : 621.32 : 621.317.39

858. Photometry. I–II. M. H. GABRIEL, C. F. KOENIG AND E. S. STEEB, JR. *Gen. Elect. Rev.*, **54**, 30–7 (*Sept.*); 23–9 (*Oct.*, 1951).

A general description of methods and apparatus used for the measurement of the luminous flux from tungsten and fluorescent lamps in a commercial laboratory. The high selectivity of the paint used for coating the integrating spheres is corrected by the use of a suitable colour filter which also corrects for the difference between the sensitivity curve of the photo-cell and the standard curve for the average eye. The cell is usually of the photovoltaic type. The electrical measurements involved are described in detail and circuit diagrams are given.

J. W. T. WALSH (R)

535.245.2 : 621.327.43 : 621.329.1

859. Luminance measurements on fluorescent lamp fittings with glare shields. R. SPIESER. *Bull. Ass. Suisse Elect.*, **42**, 792–6 (*Oct.* 6, 1951) *In German.*

Describes the direct measurement of the luminance of a fitting viewed from various directions, using the Luckiesh–Taylor brightness meter. The results of such measurements made on a number of fittings housing fluorescent tubes, both with and without glare shields, are given. J. W. T. WALSH

535.247.1

860. An optical recording photometer. W. KRAMER. *Z. Naturforsch.*, **6a**, 658–63 (*Nov.*, 1951) *In German.*

The object to be measured is imaged, by means of a cylindrical lens, upon a high-contrast photographic film. A neutral density wedge is interposed near the film. The sharp boundary, between the blackened and the clear portions of the film, is the required intensity curve. The advantages claimed are the absence of moving parts or of a slit limiting the resolution, a wider range of intensities than in other photometers, and its independence of variations of the light source. Constructional details and sample intensity curves are given. R. W. FISH

535.312 : 518.5

861. An investigation of the errors of co-ordinate machines using light beams. R. PUTSCHBACH. *Z. angew. Phys.*, **3**, 329–32 (*No.* 9, 1951) *In German.*

The Saladin co-ordinate generating machine using the reflection of a light beam from two orthogonal plane mirrors, is shown to suffer from asymmetrical pin-cushion distortion arising from the variation of the optical path length on rotation of either of the mirrors. An additional reflection from a cylindrical mirror between the two plane mirrors renders the distortion symmetrical, so that it can be corrected by simple optical methods. R. W. FISH

535.314

862. The forms of Cartesian ovals in an optical range. H. W. FARWELL. *Amer. J. Phys.*, **19**, 454–8 (*Nov.*, 1951).

Supplements an earlier discussion of Cartesian ovals [*Amer. J. Phys.*, **9**, 255 (1941)]. Assuming for the first medium a refractive index 1·00, and for the second 1·50 (and vice versa), the forms of these ovals for refraction have been studied for numerous cases. Each curve represents the form for a specified value of k, the ratio of image distance to object distance. The values of k run from $+\infty$ to $-\infty$. A.

535.317.4

863. A formula for determining the wave-surface if the spherical aberrations are known. F. I. HAVLICEK. Letter in *Nature* [*Lond.*] **168**, 743 (*Oct.* 27, 1951).

A recursion formula is given for the calculation of the co-ordinates of the wave surface, in terms of the parameter $\tan^2 \delta$. The constants of the formula are found from the corresponding constants of the series for the spherical aberration. R. W. FISH

535.33.07

864. Spectroscopic study of small samples in a hollow cathode discharge. K. B. NEWBOUND AND F. H. FISH. *Canad. J. Phys.*, **29**, 357–61 (*Sept.*, 1951).

Operating characteristics of the hollow cathode discharge have been investigated qualitatively. A sample of less than 10 μg of an element may be used to study the hyperfine structure of the principal lines in an exposure of a few hours. The useful lifetime of the sample in the discharge is about 10 hr, and up to 80% of the sample can be recovered after use. A.

535.33.07 : 535.375.5

865. An image slicer for Raman spectroscopy. J. U. WHITE. Letter in *J. Opt. Soc. Amer.*, **41**, 732–3 (*Oct.*, 1951).

A prism assembly similar to a three-prism Porro erecting system has been used to triple the illuminated slit length of the Raman spectrograph. W. R. ANGUS

535.33.07 : 535.375.5 : 621.317.794

866. Radiation measuring instruments for the infra-red to ultra-violet waveband. A. C. MENZIES. *Proc. Instn Elect. Engrs, Pt II*, **98**, 771–81 (*Dec.*, 1951) [*Paper No.* 1145].

For abstract see Abstr. 6838 (1951).

535.33.07–14

867. Molecular spectroscopy. Atomic clock. N. CARRARA. *Elettrotecnica*, **38**, 375–9 (*Sept.* 10, 1951) *In Italian.*

A review of the subject, and a description of the microwave spectroscope constructed for the microwave centre of the Italian National Research Council. L. PINCHERLE

535.33.07–15

868. Absorption spectra for wavelength calibration in the near infra-red [0·85–2·4 μ]. R. MECKE AND F. OSWALD. *Z. Phys.*, **130**, 445–8 (*No.* 4, 1951) *In German.*

Suitable emission lines (Hg and alkali metals) are tabulated. To supplement these sharp absorption bands of chloroform, trichlorethylene and benzene have been measured. Wave numbers (accurate to

2%) and extinction coefficients (accurate to about 5%) are tabulated with the actual thicknesses used (0·1–10 cm) for 48 absorption peaks. G. F. LOTHIAN

535.33.072–15

869. Improving the performance of a Littrow-type infra-red spectrometer. J. C. O. ROCHESTER AND A. E. MARTIN. Letter in *Nature* [*Lond.*] **168,** 785–6 (*Nov.* 3, 1951).

A modification which introduces an extra pair of traversals of the prism has the advantages of double dispersion and of reduction of the stray light signal by using a chopper after one dispersal. D. H. WHIFFEN

535.337 : 535.343.4

870. Study of the perturbation of the line 2 537 Å of mercury by argon, nitrogen and hydrogen at high pressures. J. ROBIN AND S. ROBIN. *C.R. Acad. Sci.* [*Paris*] **233,** 928–30 (*Oct.* 22, 1951) *In French.*

Experimental results are given which conflict with current theory [see also Abstr. 6105 (1951)]. The intensity of a satellite band with a maximum at about 2 530 Å, and which is unimportant at low pressures, increases very greatly as the pressure is raised.

R. F. BARROW

535.337 : 536.46

871. The effect of pre-heating on flame spectra. N. THOMAS. *Trans Faraday Soc.*, **47,** 958–62 (*Sept.*, 1951).

A study has been made of the effect of pre-heating on the C_2 and CH bands of a hydrocarbon flame, using a special burner which could operate at constant mass-flow over a wide temperature range. The effects of certain additives were studied at various temperatures. The results are discussed in relation to the theory that C_2 and CH are decomposition products of an intermediate in whose formation peroxides may play a part. The related experiments of Mullins are also discussed on the basis of this theory. A.

535.338.1

872. An experimental enquiry into the formation of an emission continuum resulting from negative H ions. R. FUCHS. *Z. Phys.*, **130,** 69–87 (*No.* 1, 1951) *In German.*

Spectrophotometric observations of the luminous discharge in H at high temp. (*c.* 15 000°K), and press. (*c.* 60 atm.) were used to derive the exptl. profile (line + continuum) at H_α. From a knowledge of the true line profile, the presence of a continuum due to H^- ions was detected. D. R. BARBER

535.338.1

873. Eu in oxides and sulphides of alkali earth metals. P. BRAUER. *Z. Naturforsch.*, **6a,** 561–2 (*Oct.*, 1951) *In German.*

It has been found, in agreement with theoretical lattice calculations, that Eu-containing oxides of Mg, Ca, Sr and Ba show an emission spectrum of Eu^{+++}, while the sulphides of the same elements with the same admixture of Eu disclose the presence of Eu^{++}. The preparations contained *c.* 10^{-4} g Eu. See also Abstr. 1338 (1952). F. LACHMAN

535.338.3 : 537.228.5 : 537.525.8

874. On the differences between the intensity asymmetry of the Stark effect line broadening in parallel and anti-parallel fields. R. GEBAUER AND G. OHL. *Z. Phys.*, **130,** 337–47 (*No.* 3, 1951) *In German.*

Studies were made of the intensity patterns of H_β and H_γ lines, Stark-broadened by fields parallel or in opposition to the line of flight. An explanation is given of the difference in the intensity distributions in these two cases in terms of the time necessary to establish these patterns. Field distributions in and near the canal of the discharge tube, used as particle source, are considered and their bearing on the results outlined. J. D. CRAGGS

535.338.32

875. The absolute *f*-values of the Fe I resonance lines =3 720 Å and =3 737 Å. H. KOPFERMANN AND G. WESSEL. *Z. Phys.*, **130,** 100–8 (*No.* 1, 1951) *In German.*

The atomic beam method avoids an accurate determination of the vapour pressure of the usual technique. The particle density is measured by an electric balance and the new *f*-values are found as: f(3 720 Å) = 0·043, f(3 737 Å) = 0·041. J. JACOBS

535.338.333

876. The isotope shift in the silver spectrum and the magnetic nuclear moments of Ag 107 and Ag 109. P. BRIX, H. KOPFERMANN, R. MARTIN AND W. WALCHER. *Z. Phys.*, **130,** 88–99 (*No.* 1, 1951) *In German.*

An investigation of the optical hyperfine structure of Ag I resonance lines 3 281, 3 383 Å of the separated isotopes. An interchange is necessary in the customary way of associating the respective strongest components with the isotopes. The new correlation gives nuclear magnetic moments $\mu(107) = -0{\cdot}111$, $\mu(109) = -0{\cdot}129$ nuclear magnetons. The experimental isotope shift constant is $38 \pm 6 \times 10^{-3}$ cm^{-1}. The Ag II resonance lines 3 267, 3 495 Å determine the hitherto uncertain sign of the shift agreeing with that of the nuclear volume effect. J. JACOBS

535.338.333

877. Isotope shifts in the spectrum of helium. L. C. BRADLEY AND H. KUHN. *Proc. Roy. Soc. A,* **209,** 325–33 (*Nov.* 7, 1951).

The isotope shift in 14 singlet lines and 4 triplet lines of He was measured interferometrically. Extrapolation of the change of the shift within each series allowed the isotope shift of the terms to be determined. The shifts in the higher ^1D terms were found to show anomalies which are ascribed to perturbations and hyperfine structures. The results of this work in conjunction with measurements by Fred, Tomkins and Brody lead to the conclusion that the values of the isotope shifts given by the theory of Hughes and Eckart are too small throughout by amounts up to 20%. A.

535.338.4

878. *R*-branch heads of some CO_2 infrared bands in the $CO+O_2$ flame spectrum. W. S. BENEDICT, R. C. HERMAN AND S. SILVERMAN. Letter in *J. Chem. Phys.*, **19,** 1325–6 (*Oct.*, 1951).

Several small peaks observed on the short wavelength side of the CO_2 fundamental ν_3 in the emission spectrum of the $CO+O_2$ flame are recognized as the

R-branch heads of some of the vibration-rotation bands of the CO_2 molecule. Good agreement is obtained between the observed and calculated positions of these heads. W. R. ANGUS

535.338.4 : 551.594.5

879. Laboratory reproduction of a new system of Meinel $A^2\Pi - X^2\Sigma$ bands of N_2^+ observed in aurorae boreales. R. HERMAN. *C.R. Acad. Sci.* [*Paris*] **233,** 926–7 (*Oct.* 22, 1951) *In French.*

This hitherto unobserved band-system has been obtained on spectrograms of the luminous discharge in an N_2–He_2 atmosphere (partial press. of N_2 being adjusted to suppress 1st positive bands). Bands at 7 828 Å and 8 056 Å show rotational structure similar to the Meinel bands obsd. in auroral spectra.

D. R. BARBER

535.338.4 : 551.594.5

880. Atmospheric oxygen bands in emission from neon-oxygen mixtures, and in night-sky and auroral luminescences. G. KVIFTE. Letter in *Nature* [*Lond.*] **168,** 741–2 (*Oct.* 27, 1951).

Emissions at 8 628 Å, 8 659 Å in the *n–s* spectrum, ascribed by Meinel to *R* and *P* branches of the (0,1) band of O_2, have been obtained, along with (0,0) and (1,1) bands, from 50 c/s and 2 Mc/s discharges through pure O, and Ne–O mixtures. It is probable that the bands are present also in the i.r. auroral spectrum. D. R. BARBER

535.338.4 : 551.594.51

881. A new forbidden transition of the N_2 molecule. R. HERMAN. *C.R. Acad. Sci.* [*Paris*] **233,** 738–40 (*Oct.* 1, 1951) *In French.*

The system $A^2\Pi - X^2\Sigma$ of N_2^+ [see also Abstr. 3239 (1951)] has now been obtained in the laboratory, in low-pressure discharges. At higher pressures, bands of a new system, $v \rightarrow q^1\Sigma_u^+$, of N_2 have been observed. Measurements of 8 heads are given.

R. F. BARROW

535.34 : 538.56

The extinction of e.m. waves. *See Abstr.* 1124

535.343–14 : 537.226.2 : 538.569.3

882. Study of the dielectric properties at centimetre wavelengths of water bound on silica gel. J. LE BOT AND S. LE MONTAGNER. *C.R. Acad. Sci.* [*Paris*] **233,** 862–3 (*Oct.* 15, 1951) *In French.*

Two loss peaks are found in hydrated silica gel, the stronger of which, the peak below 3 000 Mc/s at 20°C, is lost reversibly on dehydration at 110°C, and the other peak at 17 000 Mc/s persists.

D. H. WHIFFEN

535.343–14 : 537.226.2 : 538.569.3

883. Ultra-Hertzian absorption of hygroscopic salts. R. ROHMER. *C.R. Acad. Sci.* [*Paris*] **233,** 864–5 (*Oct.* 15, 1951) *In French.*

Dielectric loss at 3 cm is taken as characteristic of free H_2O and the total uptake of H_2O by Na_2SO_4 is divided into bound (hydrate) and free water. Free water is first observed after 50% hydrate formation at 30°C and after 90% formation at 18°C. $CaCl_2$ acquires free water from the beginning and $CoSO_4$ contains only hydrate water until its vapour pressure is equal to that of pure H_2O. D. H. WHIFFEN

535.343–14 : 537.226.2 : 538.569.3

884. Ultra-Hertzian absorption and water-salt equilibria. R. FREYMANN AND R. ROHMER. *C.R. Acad. Sci.* [*Paris*] **233,** 951–3 (*Oct.* 22, 1951) *In French.*

Use of dielectric loss at 3 cm to detect liquid H_2O solutions shows that $NaCl.2H_2O$, stable $+0{\cdot}2$ to $-21{\cdot}6$°C, is only formed slowly on cooling or on warming. See also Abstr. 7702 (1951).

D. H. WHIFFEN

535.343–15 : 539.13

885. An infrared study of the polymer bands of hydrogen fluoride vapor. R. D. SHELTON AND A. H. NIELSEN. *J. Chem. Phys.*, **19,** 1312–13 (*Oct.*, 1951).

Three absorption peaks at 3 228, 3 380 and 3 497 cm^{-1} at high HF pressures are attributed to H atoms in different positions, terminal, penultimate, or central, in linear HF chains. D. H. WHIFFEN

535.343–32

886. Absorption spectra of benzene in the vapour state and in the condensed [solid] state in the far ultraviolet. J. ROMAND AND B. VODAR. *C.R. Acad. Sci.* [*Paris*] **233,** 930–2 (*Oct.* 22, 1951) *In French.*

Gives curves of absorption against λ. A group of bands occurs at 1 900–2 030 Å in the vapour and displaced to 2 000–2 120 Å in the solid. A broad band has max. absorption at 1 790 Å in the vapour, which is displaced to 1 920 Å in the solid. G. F. LOTHIAN

535.343.15 : 535.375.5

887. The vibrational spectrum of ethylene oxide. H. W. THOMPSON AND W. T. CAVE. *Trans Faraday Soc.*, **47,** 946–50 (*Sept.*, 1951).

The infrared and Raman spectra of ethylene oxide have been remeasured. The rotational contour of several bands has been analysed and objections to a previous assignment of vibrational frequencies have been revealed. A reassignment has been made and the calculated and measured specific heats have been compared. A.

535.343.15 : 535.375.5

888. The vibrational spectra of ethylene imine and ethylene sulphide. H. W. THOMPSON AND W. T. CAVE. *Trans Faraday Soc.*, **47,** 951–7 (*Sept.*, 1951).

The infrared and Raman spectra of ethylene imine and ethylene sulphide have been measured. The use of higher resolving power has revealed the rotational contour of many of the infrared absorption bands, and this has been correlated with the molecular moments of inertia and symmetry. An attempt has been made to determine the magnitudes of the fundamental vibration frequencies of these molecules and to compare them with those suggested for ethylene oxide [preceding abstract]. A.

535.343.2

889. Color centers in glass. R. K. SHELINE, D. E. SHARP AND W. J. ARNER. Letter in *J. Chem. Phys.*, **19,** 1422–3 (*Nov.*, 1951).

A study is made of absorption spectra of borosilicate glasses containing radium at different times after preparation up to 7 995 days. Peaks in the spectra are ascribed to colour centres, but the latter are difficult to identify due to the chemical complexity of the glass. G. F. J. GARLICK

535.343.2 : 537.531

890. Effects of X-rays upon plastics. Electronic processes. M. J. Day and G. Stein. *Nature* [*Lond.*] **168,** 644–5 (*Oct.* 13, 1951).

Coloured plastics show a shift in absorption to longer wavelengths, when irradiated by X-rays. This shift disappears after several days in contact with oxygen, but the total absorption decreases. This is interpreted by supposing that some electrons liberated by the radiation get attached to the dye, and transfer to oxygen later. These coloured plastics are solid systems where the nature and number of electron trapping sites can be controlled. See also Abstr. 1122 (1952). C. TURNER

535.343.2–14 : 539.152.2

891. Quadrupole resonance frequencies of I^{127} nuclei in crystalline covalent iodine compounds. H. G. Dehmelt. *Z. Phys.*, **130,** 356–70 (*No.* 3, 1951) *In German.*

Absorption lines were measured in the decimetre waveband which correspond to induced transitions. The energy difference of the terms is caused by the exchange effect of the nuclear quadrupole moments with the inhomogeneous electric field of the electronic shell. The interval rule for quadrupole terms gives transition frequencies in the ratio 1 : 2 in case of rotational symmetry; in SnI_4 a positive deviation up to 5×10^{-5} was found. The absolute values of transition frequencies yield coupling constants in agreement with those found in the gaseous phase. No energetic saturation was observed, suggesting spin-lattice relaxation times of $\leqslant 10^{-3}$ sec. J. JACOBS

535.343.2–15

892. The powder method for obtaining infra-red absorption spectra: its possibilities and its difficulties. J. Lecomte. Letter in *J. Phys. Radium,* **12,** 827–8 (*Oct.*, 1951) *In French.*

535.343.4

893. The effect of a foreign gas on the absorption spectrum near the limit of the series. I. O. B. Firsov. *Zh. Eksper. Teor. Fiz.*, **21,** 627–34 (*No.* 5, 1951) *In Russian.*

An expression has been deduced for the shift of corresponding absorption lines, as a function of the configuration of the molecules of the foreign gas. The essential feature is that a large number of molecules is assumed to be within the orbit of the excited electron. F. LACHMAN

535.343.4

894. The effect of a foreign gas on the absorption spectrum near the limit of the series. II. O. B. Firsov. *Zh. Eksper. Teor. Fiz.*, **21,** 634–41 (*No.* 5, 1951) *In Russian.*

The appearance of the spectral line is determined from the expression deduced in Pt I, using the method of characteristic functions (atmospheric pressure, $t = 0°C$, $n = 10$). Since the thermal motion of molecules is not taken into account, the theoretical curves of the line-width/principal quantum number relationship lie lower than the experimental ones. F. LACHMAN

535.343.4

895. Two new absorption bands of N_2O. J. H. Taylor. Letter in *J. Chem. Phys.*, **19,** 1314–15 (*Oct.*, 1951).

Bands observed are $01^10 \rightarrow 100$ at $\nu = 696\ cm^{-1}$ and $02^00 \rightarrow 11^10$ at $\nu = 702\ cm^{-1}$. C. TURNER

535.343.4

896. Displacement of the absorption lines of Rb and K perturbed by A, He, and N_2 compressed to 1 000 atm. J. Robin and S. Robin. *C.R. Acad. Sci.* [*Paris*] **233,** 1019–22 (*Oct.* 29, 1951) *In French.*

Displacements up to 100 Å are found. The intensity ratio of the lines of a doublet varies with pressure for Rb and K. In the Rb doublet 7 800/7 947 Å the ratio passes through unity at 100 kg/cm². The former line shows reversal of displacement at high pressures of N_2. G. F. LOTHIAN

535.343.4–15

897. Note on the infrared spectrum of sulfur hexafluoride. D. Edelson and K. B. McAfee. Letter in *J. Chem. Phys.*, **19,** 1311–12 (*Oct.*, 1951).

535.343.4–15

898. Infrared spectra of CD_2CO and CHDCO. W. H. Fletcher and W. F. Arendale. Letter in *J. Chem. Phys.*, **19,** 1431 (*Nov.*, 1951).

535.343.4–15 : 535.375.56

899. Raman and infra-red spectra of germanium tetrafluoride. A. D. Caunt, L. N. Short and L. A. Woodward. Letter in *Nature* [*Lond.*] **168,** 557 (*Sept.* 29, 1951).

The Raman spectrum of gaseous GeF_4 at 1·8 atm. exhibits two lines excited by $\lambda4358$ and $\lambda4046$ Å resp., the measured $\Delta\nu$-values corresponding to the symmetrical breathing frequency of the tetrahedral molecule ($\nu_1 = 738\ cm^{-1}$). The most intense infra-red absorption band of gaseous GeF_4 lies at 800 cm^{-1} and probably corresponds to ν_3. W. R. ANGUS

535.343.4–32

900. Ultraviolet absorption spectrum of gaseous hydrogen fluoride. E. Safary. Letter in *J. Chem. Phys.*, **19,** 1319 (*Oct.*, 1951).

See Abstr. 5288 (1951). Acknowledgment of priority.

535.345 : 537.312.5

901. On the accuracy of the photoelectric measurement of extinction by means of the deflection method. J. Mika. *Acta Tech. Hungarica,* **1,** 189–97 (*No.* 1, 1951) *In German.*

Photoelectric instruments using a single cell circuit are used for measuring the transparency of a solution. A balanced two-cell circuit measures the absorption. It is shown that in spite of the balancing action of the two cells connected in series this circuit is more sensitive to variations of the light intensity of the source than is the single cell circuit. A further error is introduced by the fact that the Se cells used in the instruments are assumed to have a rectilinear response to light although this is not so. Other sources of errors are discussed as, for instance, the variation of the spectral distribution of the light source with variations in the supply voltage. It is also postulated that the above methods are inferior to the method of visual photometry. W. SUMMER

535.345.6

902. Light filters of coloured "Perspex." E. J. KING AND S. VENTURA. Letter in *Nature* [*Lond.*] **168,** 702 (*Oct.* 20, 1951).

Describes a set of 9 filters covering the visible spectrum, made by combining coloured Perspex with a gelatine red-absorbing filter. Spectral transmission curves of the coloured Perspex and the complete filters are given. R. W. FISH

535.347

903. Absorption of crystalline stilbene. P. PESTEIL. *C.R. Acad. Sci.* [*Paris*] **233,** 924–6 (*Oct.* 22, 1951) *In French.*

The absorption is measured in polarized light on thin slabs of crystal at right angles to the three main optical directions. There are two maxima near 3 670 Å and 3 870 Å, for which the absorption coefficient is different in the three directions. These are due to vibrations parallel to the shortest axis. A stronger band, just before 3 600 Å, is not dependent on direction and belongs to a vibration parallel to the largest axis. C. TURNER

535.37 : 537.312.5 : 548.0

Coloration and luminescence due to Becquerel rays together with related phenomena. *See Abstr.* 1303

535.37 : 621.327.43

904. The properties of the fluorescent lamp. G. GÜNTHER. *Tekn. Tidskr.*, **81,** 803–9 (*Oct.* 6, 1951) *In Swedish.*

The efficiency of the fluorescent powder in transforming the u.v. radiation at 2 537 Å into light at 5 200 Å depends on the process of manufacture and on treatment after manufacture, such as grinding. A grain size of 2–5 μ is usual. The layer is $\sim$10 μ thick and absorbs 7% of the light-radiation, the glare absorbs about 2%. The powder must withstand the electric discharge effects and must not react with the mercury or glass. Zn silicate, Zn–Be silicate, Ba silicate or Ca or Mg wolframate are in use. A certain after-effect of light radiation is desirable on a.c. Various methods of indicating the colour, such as colour temperature and Grassmann's trichromatic diagram, are discussed and the co-ordinates for a number of usual colours of lamps are given. True colour-rendering and its importance in commerical applications are considered and life-time, effects of voltage, flickering, adequate shading and intensity are discussed. J. A. WILCKEN (R)

535.371

905. Inertia effects in the stimulated emission of sensitized phosphors. P. BRAUER. *Ann. Phys.* [*Lpz.*] **9,** 225–34 (*No.* 5, 1951).

The time dependence of the slow rise of stimulated emission in SrS–Eu–Sm type phosphors is theoretically investigated, assuming two groups of trapping states for electrons, those due to the unsensitized phosphor SrS–Eu and those due to addition of Sm. Theoretical derivations are compared with experimental results and show good agreement. G. F. J. GARLICK

535.371

906. Luminescence of three forms of zinc orthophosphate: Mn. A. L. SMITH. *J. Electrochem. Soc.*, **98,** 363–8 (*Sept.*, 1951).

Three forms of zinc orthophosphate: manganese have been found. The α form corresponds in X-ray diffraction pattern to the published values. The luminescence is green, the peak wavelength being 5 540 Å. It is produced when manganese concentrations are below 1 mole %, or when higher concentrations are not heated above 700°C. The β form has a red luminescence with a peak at 6 380 Å. This formation occurs at manganese concentrations above 1 mole % and firing temperatures above 800°C. The γ form may be produced by additions of magnesium orthophosphate above 3 mole %. The emission is similar to the β form with a peak at 6 320 Å, and of somewhat lowered intensity. A.

535.371

907. Calcium phosphate phosphor activated with cerium and manganese. H. C. FROELICH AND J. M. MARGOLIS. *J. Electrochem. Soc.*, **98,** 400–5 (*Oct.*, 1951).

The useful deep red emission is obtained over a rather wide range of activator concentrations. Nearly all phosphor characteristics closely parallel those for the $Ca_3(PO_4)_2$: Ce parent phosphor. The ratio of sensitizer (Ce) atoms to emitter (Mn) atoms is by one or two orders of magnitude larger than in most other sensitized phosphors. Partial substitution of calcium by other elements, notably Na, lead to improved temperature stability. An optimum effect is obtained with a mole ratio of Na:Ce = 1 : 2, which approaches the 1 : 1 requirement of Kroeger's simple theory of stabilization. A.

535.371

908. An arsenic-activated zinc sulfide phosphor. J. S. PRENER. *J. Electrochem. Soc.*, **98,** 406–8 (*Oct.*, 1951).

The addition of small amounts of arsenic to ZnS produces a phosphor which has three emission bands when excited by ultraviolet light or cathode rays. The blue band at 4 650 Å is the one that is also present in unactivated ZnS phosphors. The other two bands at 5 200 Å and 6 200 Å are due to the presence of As. By a proper adjustment of the arsenic concentration, phosphors can be prepared, the emitted light of which appears white. A.

535.371

909. Copper-activated aluminosilicate phosphors. E. W. CLAFFY AND J. H. SCHULMAN. *J. Electrochem. Soc.*, **98,** 409–13 (*Oct.*, 1951).

Excitation and emission spectra are included for several typical phosphors, showing the relatively slight effects of variation in composition. The major excitation peak is in the neighbourhood of 2 600 Å. The emission spectra resemble that of $CaWO_4$, although the luminescence is slightly "whiter" and only one-third as bright. The luminescence efficiency of these phosphors is nearly independent of temperature up to 150°C, and at 115°C their brightness is equal to that of $CaWO_4$. A.

535.371

910. Luminescent barium and magnesium halophosphates. J. T. ANDERSON AND R. S. WELLS. *J. Electrochem. Soc.*, **98,** 414–16 (*Oct.*, 1951).

U is the principal useful activator in Mg and Ba halophosphates, giving rise to efficient and fairly

saturated yellow-green luminescence. Barium chlorophosphate : U, in particular, shows a strong emission peaking at 5 300 Å under both short and long ultraviolet excitation. Details of absorption characteristics and variations in base composition are discussed briefly. A.

535.371

911. Mercuric tungstate phosphor. F. E. SWINDELLS. Letter in *J. Opt. Soc. Amer.*, **41**, 731 (*Oct.*, 1951).

The combination of equi-molecular amounts of mercuric and tungstic oxides under suitable conditions results in a phosphor excited by X-rays, cathode rays and short u.v. radiation and having an emission spectrum similar to those of zinc and cadmium tungstate but less intense. G. F. J. GARLICK

535.371

912. Luminescence of zinc tantalo-niobate with manganese activator. S. LARACH. Letter in *J. Chem. Phys.*, **19**, 1318–19 (*Oct.*, 1951).

The phosphor $Zn_2Nb_2Ta_2O_{12}$: Mn has a cathodoluminescence with a spectral peak at 5 250 Å, the emission band being practically identical with that of a Zn_2SiO_4 : Mn phosphor. It is assumed that the emitting centres in both are MnO_4 groups.

G. F. J. GARLICK

535.371

913. The specific fluorescence of anthracene and other organic materials. J. B. BIRKS. Letter in *Phys. Rev.*, **84**, 364–5 (*Oct.* 15, 1951).

The non-linear relation between fluorescence and exciting particle energy in organic crystals is explained by the effect of density of ionization on transit of absorbed energy from absorption site to a fluorescent molecule. Quantitative agreement of theory with experiment is found. G. F. J. GARLICK

535.371

914. Size effects in the luminescence of ZnS phosphors. G. C. WALLICK. Letter in *Phys. Rev.*, **84**, 375 (*Oct.* 15, 1951).

Luminescence studies on different grain sizes of ZnS–CdS–Cu phosphors show that more shallow traps and surface traps for electrons exist than in larger grains. G. F. J. GARLICK

535.371

915. Stimulation of the phosphorescence of calcium-oxide-base luminescent substances by means of infra-red radiations. J. JANIN, A. CROZET AND P. CLERC. *C.R. Acad. Sci.* [*Paris*] **233**, 934–6 (*Oct.* 22, 1951) *In French.*

Synthetic phosphors made by impregnating pure $CaCO_3$ with various metal salts and heating at 1 120° for 90 min were subjected to infrared rays from a W lamp provided with a Corning 2 540 filter. No visible stimulation occurred with $CaCO_3$ impregnated with $CuCl_2$ or $MnCl_2$ alone, but stimulation was intense in presence of lead acetate, of Cu–Mn or of Pb–Mn combinations. In each case the spectrum of the stimulated emission had a sharp max. at $\lambda 1{\cdot}3\ \mu$, and a blunter max. near the limit of the visible spectrum. The importance of the physical structure of the $CaCO_3$ base is emphasized.

J. GRANT

535.371

916. Polarized fluorescence of a single crystal of pure naphthalene. S. BRODERSEN. *C.R. Acad. Sci.* [*Paris*] **233**, 1094–6 (*Nov.* 5, 1951) *In French.*

The band system between 31 650 and 27 200 cm^{-1} was photographed for different crystal orientations. The results show that the electric moment associated with the electronic transition is parallel to the shorter axis of the molecule, situated in its plane.

S. T. HENDERSON

535.371.07

917. On a cadmium iodide screen fluorescent under the influence of visible and ultra-violet radiation, cathode-rays, alpha-rays and X-rays. S. SCHLIVITCH. *C.R. Acad. Sci.* [*Paris*] **233**, 1023–4 (*Oct.* 29, 1951) *In French.*

Lead-activated cadmium iodide crystallized from aqueous or acetone solution shows fluorescence emission (4 700–6 500 Å) under excitation by visible (< 4 300 Å) and u.v. radiation, electrons, alpha-particles and X-rays. G. F. J. GARLICK

535.375.1 : 621.327.43

918. The effect of temperature on emission of fluorescent lamp phosphors. C. W. JEROME. *J. Electrochem. Soc.*, **98**, 376–83 (*Sept.*, 1951).

The effect of temperature on over-all emission of phosphors as predicted by the theory developed by Kroeger satisfactorily explains the effects found in the present study. This theory leads to reasonable values of excitation energies. The effect of temperature on the bandwidth of the emissions is satisfactorily explained on the basis of the potential energy curve theory advocated by Butler. It has been shown that this effect over an arrow temperature range can be approximated by an assumed simplified shape of the potential energy curve, but that when a wide range of temperatures is used such approximations lead to inaccurate results. A.

535.375.54

919. On the Raman spectrum of thianthrene in the solid state. S. K. MUKERJI AND B. LAL. *Indian J. Phys.*, **25**, 309–12 (*July*, 1951).

535.375.54

920. The scattering spectrum of the SiF_6 ion. L. COUTURE-MATHIEU AND J.-P. MATHIEU. Letter in *J. Phys. Radium*, **12**, 826 (*Oct.* 1951) *In French.*

The complete spectrum of the fluosilicate ion has been deduced from studies on monocrystals of $(SiF_6)(NH_4)_2$ and $(SiF_6)[Zn(OH_2)_6]$. W. R. ANGUS

535.375.54

921. Raman spectrum of a single crystal of $NaH_2PO_4 . 2H_2O$. A. GALY. Letter in *J. Phys. Radium*, **12**, 827 (*Oct.*, 1951) *In French.*

535.375.55

922. The vibration spectrum of oxalic acid in solution. R. MARIGNAN AND L. BARDET. *C.R. Acad. Sci.* [*Paris*] **233**, 1022–3 (*Oct.* 29, 1951) *In French.*

Measurements of the depolarization factors of Raman lines and the vibration spectrum of oxalic acid in saturated solution are correlated with previous results on monocrystals. The symmetry properties of the oxalate group in solution are discussed, a planar

structure with the CO groups *trans* to each other being favoured. W. R. ANGUS

535.375.56 : 539.133

923. Rotational structure of the ν_3 Raman band of methane. B. P. STOICHEFF, C. CUMMING, G. E. ST. JOHN AND H. L. WELSH. Letter in *Phys. Rev.*, **84**, 592 (*Nov.* 1, 1951).

From the 68 lines resolved in the ν_3 Raman band of CH_4 evidence has been found for 14 of the 15 sub-branches postulated by Teller's [*Hand-und Jahrb. Chem. Phys.*, **9**, 43 (*No.* 2, 1934)] theory of the Coriolis interaction in tetrahedral molecules. Values of ν_0 and the rotational constants B and D are derived from analysis of these Raman data and the infrared measurements of Nielsen and Nielsen [*Phys. Rev.*, **48**, 864–7 (*Dec.* 1, 1935)]. W. R. ANGUS

535.376

924. On the fluorescence of gases due to excitation by alpha-particles. A. E. GRÜN AND E. SCHOPPER. *Z. Naturforsch.*, **6a**, 698–700 (*Nov.*, 1951) *In German.*

Fluorescence excited in gases by alpha-particles was investigated by the use of a photomultiplier. "Technically pure" N_2 and A at ordinary pressures gave 100 times the light yield of H_2, O_2 and CO_2. Addition of organic vapours caused quenching. For N_2 1 000 quanta are emitted per alpha-particle of 4 cm range in air in the spectral region 3 000–4 000 Å. G. F. J. GARLICK

535.376

925. Cathodoluminescence characteristics of some barium-zinc-silicate phosphors with manganese activator. S. LARACH. *J. Electrochem. Soc.*, **98**, 369–70 (*Sept.*, 1951).

Spectral distribution curves of cathode-ray-excited barium-zinc-silicate phosphors with manganese activator show the existence of blue, green and red emission bands. The emission intensity of different bands was found to vary both with host crystal proportions and manganese content. A.

535.377

926. The thermoluminescence characteristics of silicate phosphors activated by manganese and arsenic. C. BULL AND G. F. J. GARLICK. *J. Electrochem. Soc.*, **98**, 371–5 (*Sept.*, 1951).

It is found that the complex distributions of the thermal activation energies of the electron trapping states in Zn_2SiO_4–Mn, $(Zn, Be)_2SiO_4$–Mn, $CdSiO_3$–Mn and $(Zn, Cd)_2$–SiO_4–Mn phosphors are greatly modified by small inclusions (1 in 10^5) of arsenic and that in all cases the total number of electron traps is greatly increased. Other silicate systems, notably $SrSiO_3$–Mn, $BaSiO_3$–Mn and $CaSiO_3$–Mn, do not show this effect. A.

535.39

927. Method for the exact measurement of absolute light phases on non-absorbing and absorbing layers. R. FLEISCHMANN AND H. SCHOPPER. *Z. Phys.*, **130**, 304–10 (*No.* 3, 1951) *In German.*

A development of the 3-slit method of Zernike for the evaluation of phase change due to a thin film. Three slits of equal width are used here, but the intensities from the slits can be continuously varied, by the employ of polarized light and suitable filters before the slits. The method is compared with that of Zernike. Experiments with five slits are also carried out. These permit phase change in both transmission and reflection to be evaluated, with increased accuracy. S. TOLANSKY

535.39 : 535.51

928. Effect of orientation on the metallic reflexion of polarized light. D. H. WOODWARD AND E. L. BRONSON. Letter in *Nature* [*Lond.*] **168**, 742–3 (*Oct.* 27, 1951).

Using crossed Nicols and a Bausch and Lomb compensator, information on the nature of three types of anisotropic reflection was obtained. Details are given for etched monel, etched isotropic aluminium and unetched anisotropic beryllium. The anisotropy of monel is attributed to a layer of hexagonal copper chromate [Abstr. 4303 (1951)]. H. G. JERRARD

535.412

929. Superposition effects in multiple-beam interference fringes. A. M. GLAUERT. *Nature* [*Lond.*] **168**, 861–2 (*Nov.* 17, 1951).

A description of multiple-beam Fizeau fringe patterns formed by placing thin sheets of glass or mica between silvered optical flats. Birefringent anomalies are described. The complexity of interpretation indicates that there will be difficulty in applying the method to the study of biological materials. The anomalies described are not explained. S. TOLANSKY

535.417 : 531.715.1

930. A photoelectric recording interferometer for measurement of dimensional changes. R. N. WORK. *J. Res. Nat. Bur. Stand.* [*Wash.*] **47**, 80–6 (*Aug.*, 1951).

A method is given for the photoelectric recording of light intensity at a reference point in an image of an interference pattern for the automatic plotting of fringe count v. thermocouple electromotive force in interferometric dilatometry. Application of the technique to the measurement of coefficients of expansion and to the determination of transition temperatures in rubber-like materials over a temperature range of −185° to +185°C is given. Transitions can be located to a precision of ±0·5 degree C and coefficients of expansion found to a precision of ±6%. A.

535.417 : 535.321 : 539.23

931. The investigation of "thick" metal films and their surface layers with the aid of the absolute phases. H. SCHOPPER. *Z. Phys.*, **130**, 427–44 (*No.* 4, 1951) *In German.*

A method is described for the determination of the refractive index within metal layers and by this means the refractive index for Ag is found to be 0·11 for the green Hg line. In addition the thickness of the transition layer between the metal and support and of the surface film on the air side are evaluated. The surface layer can be followed down to thickness of only a few molecules. The method described is an interference method using slits. Data are reported for Ag on quartz and for silver-iodide surface layers. S. TOLANSKY

535.417 : 536.44

932. Direct observation of swarm formation at the critical point of carbon dioxide. H. MEISSNER. *Z. Phys.*, **130**, 196–201 (*No.* 2, 1951) *In German.*

Describes a modification of Kappler's [*Ann. Phys.*, [*Lpz.*] **42**, 216 (1942)] microscopic interference method applied to visualize the swarms at the critical point of CO_2. F. LACHMAN

535.42

933. Light and corpuscular interference. M. RISCO. *J. Phys. Radium*, **12**, 772–6 (*Oct.*, 1951) *In French.*

A corpuscular interpretation is given of a diffraction experiment proposed by Abbe in which a grating is illuminated simultaneously by two equal beams. A relativistic treatment is given. S. TOLANSKY

535.43

934. Rayleigh scattering of light by solids. L. TAUREL AND J. P. CHAPELLE. *J. Phys. Radium*, **12**, 817–22 (*Oct.*, 1951) *In French.*

Outlines classical and quantum theories of scattering with change of wavelength, and quotes results in fair agreement. 27 refs. N. CORCORAN

535.43 : 531.259

935. The scattered light method of exploration of stresses in two- and three-dimensional models. H. T. JESSOP. *Brit. J. Appl. Phys.*, **2**, 249–60 (*Sept.*, 1951).

An examination of the theory of the photoelastic effect and of the conditions affecting the appearance of interference fringes in scattered light shows that scattered light observations provide in many cases the quickest and the most accurate means of measuring principal stress differences in a three-dimensional model, and also of separating the stresses in a two-dimensional problem. A method is developed by which a high intensity may be obtained in the light scattered from a very narrow beam traversing the model, and this, combined with an improved measuring technique, permits of a relatively high degree of accuracy in the observations. Examples are given of the use of the method in some typical problems. A.

535.43 : 548.7

Determination of molecular orientation in solids by polarization of Rayleigh scattering. *See Abstr.* 1322

535.551

936. Photoelastic determination of free boundary stresses on "frozen stress" models by an oblique incidence method. V. M. HICKSON. *Brit. J. Appl. Phys.*, **2**, 261–9 (*Sept.*, 1951).

The methods of determining the stress at the boundary of a three-dimensional photoelastic model are reviewed and the "oblique incidence" method as applied to boundary points is investigated in some detail. This method permits the complete determination of the boundary stress in a predetermined area of the boundary but is particularly susceptible to errors in observations. Tests have been carried out on a grooved cylinder in which a comparison has been made between oblique incidence determinations of the boundary stresses and determinations from slices cut in the directions of the boundary principal stresses. To obtain reasonable accuracy, extrapolation to the boundary and compensation methods of determining relative retardations are obligatory. A.

535.551

937. On the use of an ethoxyline resin in three dimensional photo-elastic measurements using the freezing technique. M. BALLET AND G. MALLET. *C.R. Acad. Sci.* [*Paris*] **233**, 846–7 (*Oct.* 15, 1951) *In French.*

The characteristics for photoelastic work of this resin are compared with those of a glycerol-phthalic resin and a resin described by Foster [see M. Frocht. *Photoelasticity.* New York and London (1948) **2**, 453]. The resin is better than glycerol-phthalic and compares favourably with the Foster resin. H. G. JERRARD

535.58

938. Rotatory dispersion measurements with a Unicam spectrophotometer. S. MITCHELL AND J. VEITCH. Letter in *Nature* [*Lond.*] **168**, 662–3 (*Oct.* 13, 1951).

Details are given of the adaptation and method of use of a spectrophotometer for rotatory dispersion measurements. Results are given for a benzene solution of caryophyllene nitrosite; the specific rotation passes through positive and negative maxima at about 6 250 Å and 7 350 Å respectively. H. G. JERRARD

535.6 : 518.3

939. Nomographs for converting between Hunter color difference meter readings and ICI color co-ordinates. F. W. BILLMEYER, JR. Letter in *J. Opt. Soc. Amer.*, **41**, 860–1 (*Nov.*, 1951).

Gives nomographs by means of which the readings on R. S. Hunter's photoelectric tristimulus colorimeter with three filters [see Abstr. 145 (1943)] can be readily converted to C.I.E. colour co-ordinates. J. W. T. WALSH

535.65 : 621.397.2

940. Color television and colorimetry. W. T. WINTRINGHAM. *Proc. Inst. Radio Engrs*, **39**, 1135–72 (*Oct.*, 1951).

The history of colour measurement and of colour photography are reviewed. The principles of modern 3-colour colorimetry are then developed from a hypothetical experiment in colour matching. The conventional theory of "perfect colour reproduction" by colour television is built up from a colorimetric background. Difficulties in applying colorimetry to colour television are mentioned. 67 references are given. A.

535.662 : 548.7

Coloration of MgO crystals. *See Abstr.* 1323

535.822

941. A new method for the observation of transparent objects. M. FRANÇON. *C.R. Acad. Sci.* [*Paris*] **233**, 1176–8 (*Nov.* 12, 1951) *In French.*

A method of viewing phase objects is described using a Savart polariscope between the object and the microscope objective. The phase object is seen doubled with "phase contrast." The sensitivity of the method can be varied by relative rotation of an analyser and polarizer. A modification of the method uses the system set to the "sensitive purple" when small differences of phase become readily visible. The method requires no alteration to the microscope itself and may be used by reflection or transmission. R. W. FISH

535.822.9

942. Phase-contrast apparatus. E. MENZEL. *Z. angew. Phys.*, **3**, 308–16 (*No.* 8, 1951) *In German.*

A review of the history and recent advances in phase-contrast microscopy. Subjects include new apparatus, the use of polarized light, coloured images, Schlieren techniques, interference microscopes, etc. 46 references are given. R. W. FISH

HEAT 536

536.1

943. Temperature function in a moving medium. R. H. RITCHIE. Letter in *J. Appl. Phys.*, **22**, 1389 (*Nov.*, 1951).

Temperature distribution in an infinite homogeneous medium moving with constant velocity past a point source is solved by the method of superposition of sources, involving a Laplace transformation and a contour integral. E. H. DOCK

536.212 : 537.311.31 : 539.11

944. The thermal and electrical conductivity of sodium at low temperatures. R. BERMAN AND D. K. C. MACDONALD. *Proc. Roy. Soc. A*, **209**, 368–75 (*Nov.* 7, 1951).

Modern theories of metallic conduction, based on the quantum interaction of electrons with the lattice vibrations, predict a considerable variation of Lorenz number with temperature. Measurements of the thermal and electrical conductivity of two rather pure specimens of sodium have been carried out continuously from 90 to ~4°K and an experimental Lorenz curve derived. Considerable deviations from theory are found; these may in part be due to departure of the lattice vibrations from the Debye spectrum. The thermal conductivity, in particular, is compared with the most recent theoretical work, and the predicted minimum at ~0·25 Θ has not been found. A.

536.212.2 : 621.315.5.017.7

945. The steady-state temperature of current-carrying, moderately long wires. J. FISCHER. *Arch. Elektrotech.*, **40**, 141–71 (*No.* 3, 1951) *In German.*

After a brief historical survey the essential differential equation is shown not to admit readily of solution; if it did, by a method indicated, it would give the answer in an inverse form. The individual terms in the equation are then examined and their physical significance criticized. It follows from the fact that the thermal conductivity of a metal is almost independent of temperature that the differential equation may be otherwise expressed as the equality of the second derivative of temperature with respect to distance and a polynomial in temperature. The coefficients of this polynomial are given by the physical data. For small temperature rises the polynomial is terminated at the linear term and the problem is easily solved for maximum temperature, terminal temperature gradient and mean wire temperature. A more general treatment follows in which the second-order equation is integrated to a first-order equation of the second degree. It follows that the two boundary conditions are related algebraically. The solution of the inverse problem mentioned above is then investigated in greater detail with special reference to the use of elliptic functions. For the special case where the polynomial terminates at the fourth-order term or higher, a numerical process is described. Finally approximate solutions are described for the direct problem in similar circumstances. S. C. DUNN

536.212.3

946. Further investigation of some errors in a dynamic method for the determination of thermal conductivity and diffusivity of insulating materials. L. N. CLARKE AND R. S. T. KINGSTON. *Aust. J. Appl. Sci.*, **2**, 235–42 (*June*, 1951).

A more detailed account of some errors in a dynamic method for the determination of thermal conductivity and diffusivity of insulating materials [see Abstr. 2597 (1951)]. An investigation of the heat loss shows that it is possible to find the size of specimen that reduces the error due to this loss to negligible proportions. It is shown that the error due to the thermal capacity of thermocouple wires having a diameter of the order of 0·01 cm becomes significant only when measuring insulators having a conductivity lower than about 0·0002 c.g.s. units. It is also shown how a correction can be found when measuring insulators having a conductivity below this value. Means of obtaining readings are discussed and an improved procedure for computing results is given. The overall accuracy of the dynamic method is also discussed and the relative importance of the various errors is considered for good and poor insulators. A.

536.252 : 537.212

947. Erratum: The influence of electric fields on the convective heat transfer in liquids. G. AHSMANN AND R. KRONIG. *Appl. Sci. Res.*, **A3**, 83–4 (*No.* 1, 1951).

See Abstr. 8693 (1950).

536.252 : 537.212

948. The influence of electric fields on the convective heat transfer in liquids. II. H. J. DE HAAN. *Appl. Sci. Res.*, **A3**, 85–8 (*No.* 1, 1951).

For Pt I, see Abstr. 8693 (1950). The measurements of Ahsmann and Kronig on the change brought about in the heat transfer from a horizontal wire to a coaxial cylinder when the intervening liquid is subjected to an electric field between the two conductors are extended to wires of different diameter and to different values of the temperature of the liquid. A.

536.413.2 : 537.311.3 : 666

949. The temperature variation of thermal expansion and electrical resistivity of a borosilicate glass. S. M. COX, J. F. STIRLING AND P. L. KIRBY. *J. Soc. Glass Techn.*, **35**, 103T–135T (*April*, 1951).

For the expansion two techniques were adopted. The first, for temperatures below the annealing range, was used to measure instantaneous change of length corresponding to a sudden temperature change and also subsequent length change during stabilization. The second was for temperatures somewhat above the annealing range, where the chief difficulty lies in correcting for viscous flow. The electrical-resistivity measurements were carried out at high

temperatures and then, by the use of a continuous-recording technique, were extended into the annealing range. The rate at which stabilization occurred was found to have a linear relationship with the reciprocal of the absolute temperature in very close agreement with that obtained from the expansion measurements. A.

536.42

950. On the determination of heats of transformation in ceramic materials. R. KRONIG AND F. SNOODIJK. *Appl. Sci. Res.*, **A3**, 27–30 (*No.* 1, 1951).

A method is described for the range of high temperatures. A.

536.421.1

951. The melting curve at high pressures. C. DOMB. *Phil. Mag.*, **42**, 1316–24 (*Nov.*, 1951).

An attempt is made to derive theoretically the Simon formula for the variation of the melting-point of a solid with pressure. The model used is similar to that of Lennard-Jones and Devonshire, but the interpretation of the results is different. A formula of the right type results, but a detailed examination shows that the melting temperatures are much too high, and the reasons for the discrepancy are discussed. The theory predicts the absence of a solid-fluid critical point, and this is in disagreement with recent general work of Münster. A.

536.421.4

952. Cryoscopy in fused lithium borate. E. DARMOIS AND G. ZARZYCKI. *C.R. Acad. Sci.* [*Paris*] **233**, 1110–12 (*Nov.* 5, 1951) *In French.*

Cooling curves are given for fused lithium metaborate, $LiBO_2$, m.p. 840° and for solutions of LiCl, NaCl, $BaCl_2$, TiO_2 and NiO in fused $LiBO_2$. From them it follows that: $LiBO_2$ is dissociated into Li^+ and BO_2^-; the chlorides are dissociated completely into their ions and give simple, double or triple depressions according to the number of ions, the oxides of TiO_2 and NiO giving simple depressions; the cryoscopic constant of $LiBO_2$ is $K = 5$; the heat of fusion $= 8{\cdot}25 \pm 0{\cdot}6$ kcal. per mol. H. H. HODGSON

536.422 : 533.5

953. The sublimation of ice in vacuum. H. KRAMERS AND S. STEMERDING. *Appl. Sci. Res.*, **A3**, 73–82 (*No.* 1, 1951).

An account is given of experiments on the rate of sublimation of ice in vacuum and in the presence of a small amount of air. The results show that the gas kinetic accommodation coefficient of the ice between −40 and −60°C lies near unity. Also it appears that the maximum sublimation rate in vacuum and at small air pressures is in agreement with the theoretical analysis given by Carman. A.

536.422 : 533.5

954. Freeze drying—vacuum sublimation. L. G. BECKETT. *J. Sci. Instrum., Suppl. No.* 1 [*Vacuum Physics*] 66–8 (1951).

A short account is given of the principles involved in the dehydration of heat-sensitive materials by sublimation from the frozen state. References are made to drying rates and important design features of commercial apparatus. A.

536.422/.423

955. The vapour pressure of hydrogen sulphide. A. M. CLARK, A. H. COCKETT AND H. S. EISNER. *Proc. Roy. Soc. A*, **209**, 408–15 (*Nov.* 7, 1951).

The vapour pressure of H_2S has been measured over the temperature range 108 to 220°K, the pressure being between 0·005 and 110 cm Hg. The results are compared, where possible, with previous measurements and are used to calculate latent heats which are compared with calorimetric data. The results indicate the occurrence of a second-order transition of the solid phase at a temperature of 127·8°K. A.

536.422.1

956. Behaviour of platinum/platinum-rhodium thermocouples at high temperatures. R. C. JEWELL AND E. G. KNOWLES. Letter in *J. Sci. Instrum.*, **28**, 353 (*Nov.*, 1951).

Examination of a dismantled furnace wound with 13% RhPt wire, after operation at 1 500°–1 600°C, showed that the Rh volatilized preferentially; a result at variance with that previously reported by McQuillan [*J. Sci. Instrum.*, **26**, 329 (1949)]. E. H. DOCK

536.423.15

957. Vapor pressures of hydrogen, deuterium, and hydrogen deuteride and dew-point pressures of their mixtures. H. J. HOGE AND R. D. ARNOLD. *J. Res. Nat. Bur. Stand.* [*Wash.*] **47**, 63–74 (*Aug.*, 1951).

These have been measured from near their triple points to their critical points. The H_2 and D_2 samples were catalysed to ortho-para equilibrium at 20·4°K. Tables suitable for interpolation have been prepared to represent the results both in c.g.s. and in engineering units. Measurements of dew-point pressures of several binary mixtures have been made at several pressures below atmospheric. Observed pressures were about 3% above those predicted by the law of ideal solutions. A.

536.423.15

958. The vapour pressure of isotopic carbon tetrachlorides. D. H. RANK AND R. E. KAGARISE. Letter in *Nature* [*Lond.*] **168**, 740–1 (*Oct.* 27, 1951).

From the negative result of an attempt to obtain by fractionation liquids of differing densities it is concluded that neighbouring isotopic molecules do not differ in b.pt. by more than 6×10^{-5} °C. L. G. CARPENTER

536.44

959. Critical temperatures, pressures, and volumes of hydrogen, deuterium, and hydrogen deuteride. H. J. HOGE AND J. W. LASSITER. *J. Res. Nat. Bur. Stand.* [*Wash.*] **47**, 75–9 (*Aug.*, 1951).

These have been determined by measuring short sections of P–V isotherms in the neighbourhood of the critical points. The H_2 and D_2 samples were catalysed to ortho-para equilibrium at 20·4°K and are designated e-H_2 and e-D_2. For e-H_2 the values found are $T_c = 32{\cdot}9_{94}$°K, $P_c = 12{\cdot}7_{70}$ atm. and $V_c = 65{\cdot}5$ cm³ mole⁻¹. For HD the corresponding values are $35{\cdot}9_{08}$°K, $14{\cdot}6_{45}$ atm. and $62{\cdot}8$ cm³ mole⁻¹; for e-D_2 the values are $38{\cdot}2_{62}$°K, $16{\cdot}2_{82}$ atm. and $60{\cdot}3$ cm³ mole⁻¹. A method of correlating isotherm data for different substances, based on the use of graphs of log P *v.* log V, is described. A.

536.44

960. Critical phenomena in the cyclohexane-aniline system. R. W. Rowden and O. K. Rice. Letter in *J. Chem. Phys.*, **19**, 1423–4 (*Nov.*, 1951).

It has been found that the coexistence curve has a flat portion for the cyclohexane-aniline mixture, and that a constant fugacity region may exist only between 29·63 and 29·90°C. F. LACHMAN

536.46

961. On the structure and combustion kinetics of diffusion flames. H. Behrens. *Z. phys. Chem.*, **197**, 1–5 (*No.* 1–2, 1951) *In German.*

Shadow photographs of hydrocarbon-air diffusion flames show two adjoining thin bright and dark bands lying within the luminous zone of the flame. These do not appear when the hydrocarbon is replaced by pure hydrogen. It is suggested that the bands arise, not from sudden changes of refractive index within the flame, but from a local accumulation of soot particles. These are formed by "cracking" of the original hydrocarbon into carbon, hydrogen and lower hydrocarbons; the carbon migrates by thermal diffusion to the boundary of the unreacted core of pure hydrocarbon, where the temp. gradient is low. Confirmation of this suggested mechanism is to be found in the fact that combustion becomes more difficult for high C/H ratios, and when the hydrocarbon is less easily "cracked." A. SCHOFIELD

536.46 : 531.571

962. Variation with pressure of the fundamental velocity of combustion in gaseous mixtures and colloidal propellants. N. Manson. *C.R. Acad. Sci.* [*Paris*] **233**, 1085–7 (*Nov.* 5, 1951) *In French.*

A comparison is made between the pressure variation of flame-speed predicted by a theory developed by the author [*C.R. Acad. Sci.* [*Paris*] **226**, 230 (1948)] and that observed in recently-published experimental results on heptane-air mixtures, $2H_2$–O_2, C_2H_2–O_2, C_2H_2–O_2–N_2 mixtures and on three colloidal propellants. It is concluded that the agreement is satisfactory, having regard to the probable inexactitude of the experimental results in some cases. The theory does not, however, explain the rapid diminution of the flame-speed of C_2H_2–O_2 mixtures at pressures < 10 mm Hg. A correction is made to an earlier paper by Manson *et al.* [*C.R. Acad. Sci.* [*Paris*] **230**, 2156 (*June* 19, 1950)] in which a method for calculating the rate of burning of colloidal propellants was proposed; it is pointed out that the proposed method is applicable to calculation of the pressure-variation of the rate of burning, and not to estimation of the absolute value of the rate of burning, as was originally claimed. A. SCHOFIELD

536.46 : 538.565

A cavity resonator method for electron concentration. *See Abstr.* 1125

536.461

963. Self-excitation of flame oscillations in tubes. H. Behrens. *Z. phys. Chem.*, **197**, 6–16 (*No.* 1–2, 1951) *In German.*

Mixtures of hydrocarbons with air were ignited at the open end of a tube 11 mm dia. and 12 m long. Over a range of mixture strengths, characteristic of the hydrocarbon, periodic variations in flame-speed (flame-oscillations) were observed as the flame passed along the tube; these were most intense when the flame had traversed about half the length of the tube, and the limits of their occurrence broadly correspond with those of unstable burning of the hydrocarbon in a diffusion flame at a burner. In some cases detonation was initiated; this always occurred near the peak of the first oscillation. It is suggested that flame-oscillations are set up by the following mechanism. Hydrogen, either present in the initial gas-mixture, or formed by cracking of hydrocarbons, diffuses rapidly through the combustion zone, thereby increasing the flame-speed. This in turn thins the reaction zone, which facilitates more rapid hydrogen diffusion, and so an unstable, accelerating flame is set up. This may become stabilized as an oscillation if the main body of unburnt gas is set oscillating with its natural frequency, but if the flame-acceleration is rapid enough, detonation is initiated before the natural oscillation can be excited. A. SCHOFIELD

536.468 : 541.126

964. Zones of inflammability of ethane, propane and butane. Evidence of a dual mechanism of combustion. R. Delbourgo and P. Laffitte. *C.R. Acad. Sci.* [*Paris*] **233**, 958–61 (*Oct.* 22, 1951) *In French.*

Mixtures of C_2H_6, C_3H_8 and C_4H_{10} with air, and with air diluted by the addition of N_2, were ignited by a succession of high-energy electric sparks at the bottom of a vertical tube 4 cm dia. and 80 cm long. Under these conditions a peninsula develops in the pressure-composition inflammability diagram, which on sufficient dilution of the oxidant becomes a separate enclosed inflammability region. For C_4H_{10} this region occurs at a pressure of approx. 200 mm Hg using a mixture of C_4H_{10}–(O_2+8N_2) containing approx. 4% C_4H_{10}. It is suggested that this separate region of inflammability indicates the existence of a double mechanism of combustion, analogous to that producing cool flames at higher pressures.

A. SCHOFIELD

536.48

965. On the temperature-dependence of the thickness of the He II film. M. I. Kaganov and B. N. Eselson. Letter in *Zh. Eksper. Teor. Fiz.*, **21**, 656–7 (*No.* 5, 1951) *In Russian.*

Criticizes Atkins's analysis of his experimental results on the oscillation method [Abstr. 8711 (1950)]. Using a corrected formula, his data for the temperature-dependence of the film thickness agree qualitatively with Jackson's [Abstr. 1721 (1950)].

R. B. DINGLE

536.48

966. Some considerations about temperature gradients in helium II. C. J. Gorter, K. W. Taconis and J. J. M. Beenakker. *Physica*, **17**, 841–6 (*Sept.*, 1951).

On the basis of the two-fluid model four different cases are considered in which stationary temperature gradients are set up in He^4 and in dilute solutions of He^3 in He^4 below the λ-temperatures. The cases under consideration are: a temperature gradient parallel to a narrow slit and a temperature gradient perpendicular to a boundary, both for the pure He^4 and for the dilute solutions. Provisional formulae are given which seem to describe the data adequately.

A.

536.48

967. Ultrasonic propagation in liquid helium near the lambda-point. A. B. PIPPARD. *Phil. Mag.*, **42**, 1209–23 (*Nov.*, 1951).

It is suggested that the sharp minimum in velocity and maximum in attenuation of ultrasonic waves in liquid He in the region of the λ-point is a consequence of fluctuations which lead to the production of inclusions of He II in He I above the λ-point, and of He I in He II below the λ-point. Expressions are derived for the velocity and attenuation in an inhomogeneous fluid, and are applied, with some modifications, to liquid He. It is found that the shape of the velocity curve may be accounted for satisfactorily, and that the observed attenuation just above the λ-point requires the inclusions of He II to consist of about 850 atoms. It is shown that fluctuation theory predicts the presence of inclusions of this size in the concentration required to explain the experimental results. A.

536.48

968. Remarks on the theory of superfluidity of a quantum liquid. B. T. GEĬLIKMAN. *Zh. Eksper. Teor. Fiz.*, **21**, 413–22 (*No.* 3, 1951) *In Russian.*

The quantization of the equations of hydrodynamics is carried out for a rotational motion of the main mass of liquid at speeds greater than a critical value. An estimate is obtained for the upper limit of the critical speed. It is shown that the formula $\Sigma^1 = \Sigma - (\vec{M\Omega})$ for the transformation of the energy Σ is not applicable to hydrodynamical excitations. R. B. DINGLE

536.48

969. Remarks on the two-fluid model of helium II. R. B. DINGLE. *Phil. Mag.*, **42**, 1080–8 (*Oct.*, 1951).

It is shown that Gorter's assumption that the forces acting on the normal and superfluid are equal and opposite is true only if there is no entropy of mixing and that his derivation of the fountain effect pressure assumes also that entropy is proportional to concentration. An additional assumption implicitly made by Gorter, Tisza and by Nakajima and co-workers—that effective mass is proportional to concentration—is pointed out. A proof is given that whatever the energy spectrum the entire entropy and internal energy and all the excited atoms (or excitations) follow the motion of the tube in which they are contained; this is not in agreement with Temperley's suggestion that other states besides the very lowest one contribute to the superfluid density. The extra terms arising from the creation of new phonons during the motion of the normal fluid is calculated. The status of the relation $\rho_n \propto S$ in the two-fluid theory, the theoretical condition determining the lambda-point and the expected differences in behaviour of He^4 and He^3 are discussed. A.

536.531

970. The use of thermistors. Y. DOUCET. Letter in *J. Phys. Radium*, **12**, 823 (*Oct.*, 1951) *In French.*

Comments on thermistors as sensitive thermometers. The best are the type "F," in which sporadic fluctuations limit the precision to about $\pm 0{\cdot}002$°C. The curve $\log R$ *v.* $f(1/T)$ is not linear, as suggested by theory. However, thermistors are well adapted for use in thermostats where the above precision is ample. A. H. W. BECK

536.531 : 539.4.016.3

Annealing of platinum for thermometry. *See Abstr.* 1253

536.581

971. Discussion of the stability of thermal control by the method of the fusion of roots. P.-L. DUBOIS-VIOLETTE. *C.R. Acad. Sci.* [*Paris*] **233**, 730–2 (*Oct.* 1, 1951) *In French.*

The method previously applied to the stability of servo-mechanism regulators [*C.R. Acad. Sci.* [*Paris*] **230**, 1380–3 (*April* 12, 1950); Abstr. 2397 B (1950)] is applied to heat problems with special reference to proportional, derivative and integral control systems. E. H. DOCK

536.6.084

972. On the gravimetric determination of thermal characteristics of plastic materials. G. PLATO. *Z. angew. Phys.*, **3**, 263–7 (*No.* 7, 1951).

A recording balance within a steam calorimeter is used to determine simultaneously the specific heat and thermal conductivity, within certain limits. The theory of the method is considered in detail and the apparatus is described. The technique is particularly suitable for materials which can be classed as thermal insulators, but is not suitable for thermal conductors. E. H. DOCK

536.633

973. Specific heat of He^3. E. M. LIFSHITS. Letter in *Zh. Eksper. Teor. Fiz.*, **21**, 659–61 (*No.* 5, 1951) *In Russian.*

An interpretation of data on the vapour pressure of He^3 assuming a Fermi energy spectrum leads to a value for the specific heat of $0{\cdot}76\ RT$ cal/mol/deg. R. B. DINGLE

536.652 : 539.1

974. A note on the paper "On the latent heat of fusion and the hole theory," N. R. Mukherjee. A. K. MUKHERJEE. Letter in *J. Chem. Phys.*, **19**, 1431 (*Nov.*, 1951).

A criticism of a number of assumptions made in the above-mentioned paper [Abstr. 5370 (1951)]. T. C. TOYE

536.662

975. Heats of combustion and formation of some organosilicon compounds. T. TANAKA, U. TAKAHASHI, R. OKAWARA AND T. WATASE. Letter in *J. Chem. Phys.*, **19**, 1330 (*Oct.*, 1951).

The heats of combustion of 5 organosilicon compounds have been determined by the calorimetric bomb method, and their heats of formation calculated. F. LACHMAN

THERMODYNAMICS 536.7/.8

536.7

976. Thermodynamical properties of nitrogen as functions of density and temperature between −125° and +150°C and densities up to 760 amagat. A. MICHELS, R. J. LUNBECK AND G. J. WOLKERS. *Physica*, **17**, 801–16 (*Sept.*, 1951).

The experiments carried out in the Van der Waals' Laboratory supplied these data only between 0° and

150°C for pressures up to 3 000 atmospheres. Compressibility data overlapping those mentioned, but extending in temperature down to −185°C and in pressure up to 6 000 atmospheres, have been published elsewhere. From these data thermodynamical functions have been calculated for temperatures between −125°C and +150°C and densities up to 760 amagat (pressure about 5 500 atmospheres). A.

536.7

977. Thermodynamics of ferrous sulphide. C. B. ALCOCK AND F. D. RICHARDSON. Letter in *Nature [Lond.]* **168**, 661–2 (*Oct.* 13, 1951).

The free energy of formation of β-ferrous sulphide is measured from 720 to 1 260°K, using radiosulphur. The result: $\Delta G^{\circ}_{720-1260\,K} = -71\,820 + 25{\cdot}12T$ cal, is compared with results of others. C. TURNER

536.7

978. On the principle of thermal interaction. P. MAZUR. Letter in *J. Chem. Phys.*, **19**, 1431 (*Nov.*, 1951).

Holtan [Abstr. 5846 (1951)] introduced a new principle to describe the interaction between different transport phenomena in non-isothermal systems by means of known thermodynamic functions only; the basic ideas are now critically examined. It is concluded that, in general, the mutual interaction coefficients cannot be expressed in the way proposed and that the hypothesis is unacceptable as a new general principle of irreversible thermodynamics.

F. E. HOARE

536.71

979. Low temperature second virial coefficients for a 6–12 potential. L. F. EPSTEIN AND G. M. ROE. Letter in *J. Chem. Phys.*, **19**, 1320–1 (*Oct.*, 1951).

Calculations of values of $G(\theta)$ for $0{\cdot}5 < \theta(0{\cdot}5) < 8{\cdot}0$ using tables of the confluent hypergeometric function are in good agreement with previous evaluations. A modified equation is used to compute a table of values of $G(\theta)$ for large θ. C. TURNER

536.75, 536.79

980. The gas imperfection correction for the entropy of ethyl and methyl alcohol. K. ITO. Letter in *J. Chem. Phys.*, **19**, 1313–14 (*Oct.*, 1951).

A method of correction is proposed based on the relationship between the imperfection corrections for entropy and latent heat deduced from Berthelots' equation. If vapour pressure and heat of vaporization data are available the entropy imperfection correction may be calculated. This method eliminates $\frac{2}{3}$ of the observed vaporization entropy error. Numerical results are given for ethyl and methyl alcohol and compared with those obtained by other methods. F. E. HOARE

ELECTRICITY 537

THEORY. ELECTRONS 537.1

537.12

981. A new classical theory of electrons. P. A. M. DIRAC. *Proc. Roy. Soc. A*, **209**, 291–6 (*Nov.* 7, 1951).

In the theory of the electromagnetic field without charges, the potentials are not fixed by the field, but are subject to gauge transformations. The theory thus involves more dynamical variables than are physically needed. It is possible by destroying the gauge transformations to make the superfluous variables acquire a physical significance and describe electric charges. One gets in this way a simplified classical theory of electrons, which appears to be more suitable than the usual one as a basis for a passage to the quantum theory. A.

537.122

982. The "electric flywheel" and the inertia of electrons. P. SELÉNYI. *Z. Phys.*, **130**, 124–8 (*No.* 1, 1951) *In German.*

This note gives a brief discussion of earlier work on the mechanical effects of electron clouds, as found in, for example, tubes containing hinged filaments. An assessment of a previous expt. by the author in which, at first sight, momentum was not conserved is given and the paradox is explained. J. D. CRAGGS

537.13 : 539.165

Existence and nature of the "positive particles" near a source of radium E. *See Abstr.* 1199

ELECTROSTATICS . DIELECTRICS 537.2

537.21, 538.123

983. General solutions of the equations of electrostatics and magnetostatics. E. DURAND. *C.R. Acad. Sci. [Paris]* **233**, 1008–10 (*Oct.* 29, 1951) *In French.*

A general identity,

$$\int_V \{[(\nabla \times \boldsymbol{A}) \times \nabla(1/r)] + \nabla(1/r) \,.\, (\nabla \,.\, \boldsymbol{A})\} dV - \int_S \{(\boldsymbol{n} \,.\, \boldsymbol{A})\nabla(1/r) + [(\boldsymbol{n} \times \boldsymbol{A}) \times \nabla(1/r)]\} dS = 4\pi \boldsymbol{A}(\boldsymbol{r}')$$

for $\boldsymbol{r}'$ inside S, $= 0$ for $\boldsymbol{r}'$ outside S, is deduced and applied to the cases $\boldsymbol{A} = \boldsymbol{E}$, $\boldsymbol{H}$ and $\boldsymbol{A}$ (vector potential). E. P. WOHLFARTH

537.22 : 537.531

984. New developments in xeroradiography. R. C. MCMASTER. *Non-destr. Test.*, **10**, 8–25 (*No.* 1, 1951).

The basis of xeroradiography, the method of producing X-ray images by means of dry powders without any chemical processing, is the phenomenon produced by insulators of normally high quality becoming relatively good conductors under the impact of X-rays. The xeroradiographic plate must be sensitized before use. This is done by charging electrically the outer surface of the sensitive film. During X-irradiation the surface charge will leak away. The rate of loss is proportional to the local intensity of the X-rays. The electrostatic image is rendered visible by a pigmented powder. Visible images may be produced within a few seconds after X-irradiation. The image may be temporarily fixed or can be transferred to paper as a permanent record (adhesive method). A detailed description of both methods (cascade development; powder cloud development) is given. The use of intensifying screens is deprecated.

W. SUMMER

537.221 : 621.319.7

985. Reduction of static electrification by means of inhibiting compounds. G. W. GRAHAM. Letter in *Nature* [*Lond.*] **168,** 871–2 (*Nov.* 17, 1951).

Describes a method for measuring the effect of antistatic agents on nylon yarn. Results for five liquids are given and a mechanism for their action is suggested. G. HOWELLS

537.226

986. On the mechanical action in dielectrics. W. B. SMITH-WHITE. Letter in *Proc. Phys. Soc.* [*Lond.*] *A*, **64,** 945–6 (*Oct.*, 1951).

Cade's objection [Abstr. 9439 (1951)] to $F = (P.\nabla)E$ for the mechanical force density acting in a dielectric is due to a misunderstanding of the author's theory. I. D. L. BALL

537.226.2 : 538.565

987. The refractive indices and dielectric constants of air and its principal constituents at 24 000 Mc/s. L. ESSEN AND K. D. FROOME. *Proc. Phys. Soc.* [*Lond.*] *B,* **64,** 862–75 (*Oct.*, 1951).

The method is based on the measurement of the resonant frequency of a cavity resonator first when it is filled with the gas and then when it is evacuated. The source of oscillations used is a Pound-stabilized velocity-modulated oscillator, and its frequency is measured by reference to a high harmonic of a quartz standard, with a precision of 1 part in 10^8. The cavity is provided with a tuning plunger, which changes the resonant frequency through a range of about 10 Mc/s, and is calibrated to an accuracy of within 1 kc/s. Most of the measurements were made by the frequency-change method and the plunger was used in a narrow region only for a precise setting to resonance. It is possible by a larger movement of the plunger to compensate for the whole frequency change due to the removal of the gas and thus to work at a fixed frequency. The dielectric constants can be calculated from the relationship $\mu\varepsilon = n^2$, where μ is the magnetic permeability and ε the dielectric constant, the values of $(\mu - 1)10^6$ being taken as 0·4 for air, 1·9 for oxygen and zero for the other gases. Accurate formulae are given for obtaining the refractive index of moist air at different atmospheric conditions, and are reduced to a simple formula which is applicable for normal atmospheric conditions. A.

537.226.2 : 538.569.3 : 535.343–14

Dielectric properties at centimetre wavelengths. *See Abstr.* 882–4

537.226.2 : 539.32 : 537.228.1

988. Theory of barium titanate. II. A. F. DEVONSHIRE. *Phil. Mag.*, **42,** 1065–79 (*Oct.*, 1951).

For Pt I, see Abstr. 956 (1950). The phenomenological theory of $BaTiO_3$ has been extended, and expressions obtained for the piezoelectric constants, elastic coefficients for constant field and dielectric constants for constant strain in terms of other physical constants of the material. Curves are drawn showing these quantities as functions of temperature, and some comparison made with experiment. The relations of the constants of the ceramic to those of the single crystal are then briefly discussed. A.

537.226.2 : 621.315.612.4

989. Dynamics of barium titanate polarization process. E. V. SINYAKOV, E. A. STAFIĬCHUK AND B. K. CHERNYĬ. *Zh. Eksper. Teor. Fiz.*, **21,** 610–17 (*No.* 5, 1951) *In Russian.*

Short, rectangular d.c. impulses were used to investigate the polarization process above and below the Curie point. Relations between permittivity and voltage were derived with impulse times of 10^{-3}–10^{-6} sec. A hypothesis is put forward that admixture of Ba ions plays the principal role in the development of ferroelectric properties in $BaTiO_3$. J. LUKASZEWICZ (R)

ELECTRIC CONDUCTION . CURRENTS 537.3

537.311.1 : 532.5

990. The steady and oscillatory flow of the electron fluid when bound to a lattice. B. T. GEĬLIKMAN. *Zh. Eksper. Teor. Fiz.*, **21,** 618–26 (*No.* 5, 1951) *In Russian.*

Theoretical. Solutions are obtained for the hydrodynamic equations of an electron fluid which is bound to a lattice for the case of the macroscopic motion of the bulk of the fluid at speeds which exceed the critical speed (when the magnetic field exceeds the critical intensity). The frequencies of the bound oscillations of the electron fluid in the lattice are found. In the case of metals the usual Debye theory proves inadequate. A. L. MACKAY

537.311.3 : 537.226.2 : 666

991. The electrical properties of some lithia-containing glasses. A. E. DALE, E. F. PEGG AND J. E. STANWORTH. *J. Soc. Glass. Techn.*, **35,** 136T–145T (*June*, 1951).

Measurements of thermal expansion, d.c. electrical resistivity, dielectric constant and loss angle have been made on glasses from selected parts of the composition fields: Li_2O–SiO_2, Li_2O–B_2O_3, Li_2O–B_2O_3–SiO_2, Li_2O–B_2O_3–Al_2O_3–SiO_2, Li_2O–Na_2O–B_2O_3–Al_2O_3–SiO_2, Li_2O–K_2O–B_2O_3–Al_2O_3–SiO_2 and Li_2O–CaO–B_2O_3–Al_2O_3–SiO_2. As a result of the investigation, it has been found possible to prepare glasses of low electrical resistivity (10^9–10^{19} ohms/cm^3 at room temperature), and of low loss angle (values of tan δ as low as 0·0011 at frequencies of 1 Mc/s). A.

537.311.31

992. Conductivity of the sodium tungsten bronzes. B. W. BROWN AND E. BANKS. Letter in *Phys. Rev.*, **84,** 609–10 (*Nov.* 1, 1951).

Measurements of resistivity of these materials (Na_xWO_3, where x varies between 0·5 and 0·85) in the form of single crystals are reported. The resistivity increases linearly with temperature in the range −160 to +360°C for all samples, and the dependence of the values on the variable x is described, and possible reasons for the behaviour are given. C. A. HOGARTH

537.311.31 : 539.11 : 536.212

Electrical conductivity of sodium at low temperatures. *See Abstr.* 944

537.311.33

993. Some conduction properties of the oxides of zinc and copper. C. A. HOGARTH. *Z. phys. Chem.*, **198**, 30–40 (*No.* 1–4, 1951).

The electrical conductivity and thermo-electric power of ZnO and Cu_2O are measured as functions of both temperature and oxygen pressure, and are found to be in general agreement with theories previously put forward. Exact numerical agreement for the derived constants is not found, although the results of thermo-electric measurements are in closer agreement with theory. Measurements of the thermo-electric power of CuO indicate that this substance is an excess semiconductor, but its variation with oxygen pressure is in the opposite sense to that expected for such a material. Possible reasons for the discrepancies between theory and experiment are offered. A.

537.311.33

994. The electrical properties of cuprous iodide. B. H. VINE AND R. J. MAURER. *Z. phys. Chem.*, **198**, 147–56 (*No.* 1–4, 1951).

The electrical conductivity and Hall coefficient of CuI containing excess I have been measured as functions of temperature and of the pressure of I vapour in equilibrium with the compound. CuI containing excess I is a defect conductor. The concentration of free holes and their mobility depend upon the temperature and the concentration of excess I. The thermal activation energy for the production of a free hole decreases as the concentration of excess I increases. The mobility of the free holes initially decreases and then increases as the concentration of excess I increases. A.

537.311.33

995. A.c. characteristics of Si *p–n* junction. S. KOMAGATA, M. HATOYAMA, M. SHIBUYA, W. SASAKI, T. YAMAMOTO AND M. KIKUCHI. Letter in *J. Appl. Phys.*, **22**, 1290 (*Oct.*, 1951).

Rectification ratios at $\pm$ 1 V were from 80 to 100. The slope of the log current *v.* voltage curve was as small as 15 instead of the theoretical value of 40 which has been observed with *p–n* junctions in Ge. Characteristics for the frequency range 200 c/s to 150 kc/s were analysed. C. A. HOGARTH

537.311.33 : 535.32

996. Optical constants of germanium, silicon, and pyrite in the infrared. I. SIMON. Letter in *J. Opt. Soc. Amer.*, **41**, 730 (*Oct.*, 1951).

The purpose of this communication is to point out the possibility of applying the reflection method to the investigation of the optical properties of semiconductors. The method involves the measurement of the reflecting power of the plane, polished surface of a bulk sample at two different angles of incidence (e.g. 20° and 70°). The refractive index and the absorption index are then obtained by a graphical analysis. The advantage of the method lies in the ease of preparation of samples and its applicability in a wide wavelength interval. The limitation of the method is its insensitivity in the region of small values. Data are reported in the region 600–2 400 cm^{-1}. S. TOLANSKY

537.311.33

997. A theory of electrical fluctuations in semiconductors. M. SURDIN. *J. Phys. Radium*, **12**, 777–83 (*Oct.*, 1951) *In French.*

When a current passes through a semiconductor filament or a crystal detector, the fluctuations may be 10 times as great as the theoretical thermal noise. The noise current $(\overline{i_\nu^2})^{\frac{1}{2}}$ is approximately proportional to the mean current flowing; $\overline{i_\nu^2}$ decreases with frequency as $1/\nu$, and as $1/\nu^2$ for very high frequencies. The phenomena are explained in terms of a fluctuation in the number of current carriers in the case of a filament and in the number of donor or acceptor centres in the case of the metal/semiconductor contact. C. A. HOGARTH

537.311.33

998. Hot electrons in germanium and Ohm's law. W. SHOCKLEY. *Bell Syst. Tech. J.*, **30**, 990–1034 (*Oct.* (I) 1951).

The data of E. J. Ryder on the mobility of electrons in electric fields up to 40 000 V per cm are analysed. The mobility decreases many fold due to the influence of scattering by optical modes and due to increases of electron energy. It is estimated that electron "temperatures" as high as 4 000°K have been produced in specimens having temperatures of atomic vibration of 300°K. The critical drift velocity above which there are deviations from Ohm's law is about $2{\cdot}6\times 10^6$ cm/sec. This is three times higher than the elementary theory and an explanation in terms of complex energy surfaces is proposed. A.

537.311.33

999. Some results concerning the partial differential equations describing the flow of holes and electrons in semiconductors. R. C. PRIM. *Bell Syst. Tech. J.*, **30**, 1174–1213 (*Oct* (II) 1951).

The subject equations are investigated in order to establish some general properties of the flow fields which they describe, including the existence or non-existence of classes of exact solutions having certain formal properties. The results include a number of geometric characteristics of the vector fields involved, a suggestive reformulation of the partial differential equations restricting carrier concentration and electrostatic potential, and several classes of exact solutions involving arbitrary constants and/or functions. Of particular interest is a family of solutions in closed form for the steady-state, no-recombination case involving an arbitrary harmonic function in three dimensions. A.

537.311.33

1000. The electrical conductivity of liquid germanium. R. W. KEYES. Letter in *Phys. Rev.*, **84**, 367–8 (*Oct.* 15, 1951).

The resistivity of liquid Ge near the m.pt. measured by the effect on the impedance of a surrounding coil, was found to be 60×10^{-6} ohm cm and the temperature coefficient positive and about 1 or 2×10^{-4} $(°C)^{-1}$. Similarities between the transition from solid to liquid Ge and from grey to white Sn are observed. C. A. HOGARTH

537.311.33

1001. *P–N* transition of an oxide-coated cathode. Y. ISHIKAWA, T. SAKO, K. OKUMURA AND T. SASAKI. Letter in *Phys. Rev.*, **84**, 371–2 (*Oct.* 15, 1951).

Theory and experiments on the nature of the conduction in (Ba, Sr)O coated cathodes are described and large values of apparent electron and hole mobility are reported. C. A. HOGARTH

537.311.33

1002. The barrier layer of a germanium rectifier in the current region. W. BÖSENBERG AND E. FUES. *Z. Naturforsch.*, **6a**, 741–4 (*Nov.*, 1951) *In German.*

A calculation for the field and concentration distribution of electrons and holes in the Schottky barrier region of a metal/Ge contact is carried out on the assumption that injection in the region of an emitter contact arises through Schottky effect. For large currents it predicts a large increase in the hole and electron concentration. C. A. HOGARTH

537.311.33

1003. A note on the partial differential equations describing steady current flow in intrinsic semiconductors. R. C. PRIM. Letter in *J. Appl. Phys.*, **22**, 1388–9 (*Nov.*, 1951).

Using Van Roosbroek's treatment [Abstr. 1053 (1951)] of the flow of electrons and holes in solids, in the absence of space charge effects and volume recombination, a solution of the equations in the form of a conjugate pair of plane harmonic functions is obtained. C. A. HOGARTH

537.311.33

1004. An effect of light on semiconductors: a variation in the contact potential difference. W. VEITH AND G. WLÉRICK. *C.R. Acad. Sci.* [*Paris*] **233**, 1097–9 (*Nov.* 5, 1951) *In French.*

A method of preparing a highly sensitive CdS layer and operating it *in vacuo* is described. It is found that a formula will describe with sufficient accuracy the variation of the difference of the contact potential between a reference metal and a semiconductor when the latter is illuminated and then obscured. This difference increases with the ambient temperature. The curves obtained with the semiconductor illuminated and then dark are strictly parallel up to saturation point. W. SUMMER

537.311.33

1005. The electrical resistivity of gallium and some other anisotropic properties of this metal. R. W. POWELL. *Proc. Roy. Soc. A*, **209**, 525–41 (*Nov.* 22, 1951).

It is shown that single crystals of Ga can be produced with considerable ease, and that these crystals show greater anisotropism in their conducting properties than those of other metals. At normal temperatures the electrical conductivities for the three axial directions $c : a : b$ are in the ratio $1 : 3{\cdot}2 : 7$, and the expansion coefficients are in the ratio $1 : 0{\cdot}7 : 1{\cdot}9$. Results are given showing that these ratios persist down to −180°C with relatively little change. From preliminary observations at normal temperature it seems that the thermal conductivity varies much as does the electrical conductivity and that the mechanical properties will also prove to be markedly anisotropic. A.

537.311.33

1006. Electrical resistivity of gallium single crystals at low temperatures. M. OLSEN-BÄR AND R. W. POWELL. *Proc. Roy. Soc. A*, **209**, 542–50 (*Nov.* 22, 1951).

Electrical resistivity measurements on single crystals of Ga grown to conform approximately to the three axial directions have been extended to low temperatures, detailed investigation being made over the range 20·4 to 4·2°K. The anisotropy of this property increases in this region where the resistivity ratios for the three specimens are approximately $1 : 2{\cdot}1 : 8$ compared with $1 : 2{\cdot}1_6 : 6{\cdot}5_5$ at room temperature. The "ideal" resistivity is proportional to T^n, where $n \simeq 4{\cdot}45$ for the range 5 to 12°K and decreases to about 3·9 for the range 12 to 20·4°K. The characteristic temperatures as derived from Grüneisen's expression show relatively small differences for the three axial directions but decrease with decrease in temperature. Comparable variations with temperature are observed in the characteristic temperatures derived previously from specific heat measurements on Ga. A.

537.311.33 : 621.314.63

1007. Crystal diode and triode action in lead selenide. C. A. HOGARTH. Letter in *Proc. Phys. Soc.* [*Lond.*] *B*, **64**, 822–3 (*Sept.*, 1951).

Relatively impure specimens of PbSe have been found to act as crystal rectifiers. The *p*-type specimens could be electro-formed into excellent diodes and transistor action was observed. Voltage gains up to 7 and power gains of 1·5–2 could be obtained.

C. A. HOGARTH

537.311.37

1008. A general formula for the conductivity of a gas containing free electrons. L. G. H. HUXLEY. *Proc. Phys. Soc.* [*Lond.*] *B*, **64**, 844–61 (*Oct.*, 1951).

Contains a general discussion of electron drift in gases according to the method of free paths in which a fallacy contained in some earlier treatments is avoided. A general formula is derived for drift velocity in an electric field which is an arbitrary function of the time, and from it formulae for drift velocities in the following special cases of importance are deduced: drift in a constant electric field, in an alternating sinusoidal field, in a constant electric field with an applied magnetic field, in an alternating electric field with an applied magnetic field. Formulae for the electrical conductivity of an electron-laden gas follow from those for the drift velocities. Applications of the formulae to ionospheric and other studies are mentioned. A.

537.312.5

1009. A photo-conductive effect in tellurium film. W. T. BLACKBAND. Letter in *Nature* [*Lond.*] **168**, 704 (*Oct.* 20, 1951).

The resistivity of a thin film of Te decreases on exposure to light and is slowly restored to normal when kept in darkness for a number of hours (about 18 to 20 hours). W. SUMMER

537.312.5

1010. On activated cadmium sulphide photo-electric cells. P. Goercke. *Ann. Télécommun.*, **6**, 325–31 (*Nov.*, 1951) *In French.*

A review of important properties of CdS-photocells is followed by a study of the influence of copper and silver activation on the spectral distribution of sensitivity, internal resistance, background noise and inertia of the cells. Combining suitable activators enables modification of spectral response at wavelength between 0·3 and 1·6 μ. A. SCZANIECKI

537.312.5 : 539.21

1011. Capture and collision processes for excitons in alkali halides. D. L. Dexter and W. R. Heller. Letter in *Phys. Rev.*, **84**, 377–8 (*Oct.* 15, 1951).

Some theoretical mechanisms for the external photoelectric effect in alkali iodides are considered which involve the properties of excitons and their interactions with F centres and other lattice defects. An explanation of the experimental results of Apker and Taft is attempted with some success [Abstr. 4391, 7900 (1951)]. G. F. J. GARLICK

537.312.5 : 621.383

1012. On the signal-to-noise ratio of the multiplier phototube 1P21. S. Hata. Note in *Publ. Astron. Soc. Japan*, **2**, 90–1 (*No.* 2, 1950).

The rapidly-varying noises, especially those with low audible frequencies, have been examined with a view to applying the results to the observations of meridian transits and lunar occultations.

M. W. OVENDEN (R)

537.312.6 : 538.221

1013. The resistivity of ferrites of zinc, nickel, cobalt, magnesium, and copper, as a function of temperature. L. Bochirol. *C.R. Acad. Sci.* [*Paris*] **233**, 736–8 (*Oct.* 1, 1951) *In French.*

The resistivity ρ as a function of temperature in the range 100–700°C, and the variation for various heat treatments is investigated. For all samples $\log \rho$ *v.* $1/T$ gave straight line plots, with ρ_{100} of order 10^6 ohm cm and ρ_{700} of order 10 to 30 ohm cm, for the slow cooling experiments. Rapid thermal treatments cause irreversible changes in values of ρ. C. A. HOGARTH

537.312.62

1014. Statistical thermodynamics of the superconducting state. H. Ichimura. Letter in *Phys. Rev.*, **84**, 375–6 (*Oct.* 15, 1951).

Application of Fröhlich's theory to Abstr. 5845 (1950). Expressions for the free energy and the change of the specific heat at the critical temperature are given. H. LONDON

537.312.62

1015. The intermediate state of superconductors. E. M. Lifshits and Yu. V. Sharvin. *Dokl. Akad. Nauk, SSSR*, **79**, 783–6 (*No.* 5, 1951) *In Russian.*

It is shown that for specimens of reasonable size the free energy of the intermediate state in Landau's first (non-branching) model [*Phys. Z. Sowjet*, **11**, 129 (1937)] is less than in his later (branching) model [Abstr. 1842 (1945)] and this explains why the "mixed" state at the surface is not in fact observed [Meshkovski and Shalnikov, Abstr. 2563 (1947)]. It is shown that only one or two branchings would be expected to occur in a specimen 2 cm wide.

D. SHOENBERG

537.312.62

1016. Kinetics of destruction of superconductivity by a magnetic field. I. M. Lifshits. *Zh. Eksper. Teor. Fiz.*, **20**, 834–41 (*No.* 9, 1950) *In Russian.*

The kinetics of the transition from the superconducting to the normal state in a magnetic field exceeding the critical is discussed theoretically. Assuming that the applied field does not change too fast and does not exceed the critical value too strongly it can be assumed that the motion of the boundary takes place without inertia and the problem can be discussed within the framework of phenomenological theory. The equations of electrodynamics and thermal conductivity are simultaneously solved and it is shown that in certain conditions the thermal effects may have an important influence on the kinetics. The speed of motion of the boundary is determined as a function of time, applied field and other relevant parameters [see also Pippard, Abstr. 4096 (1950)].

D. SHOENBERG

537.312.62

1017. On the theory of superconductivity. V. L. Ginzburg and L. D. Landau. *Zh. Eksper. Teor. Fiz.*, **20**, 1064–82 (*No.* 12, 1950) *In Russian.*

It is pointed out that the London equations for superconductivity cannot explain a positive surface energy and lead to difficulties in the interpretation of experimental results on destruction of superconductivity by magnetic fields. An attempt is made to improve the situation by modifying the fundamental ideas of the London theory; a function ψ is introduced such that $|\psi^2|$ may be considered as the density of "superconducting" electrons. The free energy in a magnetic field is assumed to contain a term proportional to $|\text{grad}\,\psi|^2$ with the consequence that energy contributions arise not only from the kinetic energy of the supercurrent but also from any spatial variation of the concentration of superconducting electrons; this produces a tendency to long-range order so that, for instance, at a boundary between normal and superconducting phases there is a relatively gradual transition of $|\psi|^2$. The form of this transition is calculated by minimization of the free energy and hence the interphase surface energy is evaluated in terms of the critical field and the penetration depth but no adjustable parameters. The calculations apply only close to T_c, where reasonable agreement with experiment is obtained. The field variation of penetration depth is then calculated and found to be very small. Next the destruction of superconductivity of thin films by magnetic fields is discussed and the results of Appleyard *et al.* [*Proc. Roy. Soc. A*, **172**, 540–58 (*Sept.* 15, 1939)] analysed to give estimates of the penetration depth, which are claimed to be in tolerable agreement with experiment. Finally the destruction of superconductivity in thin films by currents is discussed. See also Pippard, Abstr. 7904 (1951) and Abstr. 8756 (1950).

D. SHOENBERG

537.312.62

1018. Critical magnetic fields of superconducting tin films. N. V. ZAVARITSKIĬ. *Dokl. Akad. Nauk, SSSR*, **78**, 665–8 (*No.* 4, 1951) *In Russian.*

Resistance measurements are described of the critical fields h of Sn films of thicknesses, d, $4{\cdot}4\times10^{-6}$ cm to $1{\cdot}5\times10^{-4}$ cm, evaporated on to glass in high vacuum conditions. The transitions were sharp ($\sim 0{\cdot}01°$K wide) and the transition temperatures ($3{\cdot}75°$K to $3{\cdot}84°$K) were not much different from those of bulk Sn. For the thicker films the relation $h/H_c = 1 + 7\times10^{-6}/d$ was found for $T_c - T = 1{\cdot}3°$K (H_c = critical field of bulk Sn); for the thinner films h/H_c varied more rapidly as d is reduced. The results are found to be in agreement with the theory of Ginzburg and Landau [preceding abstract]; on the basis of this theory values of the penetration depth are deduced which are about 20% higher than those found from experiments on bulk Sn [Abstr. 7023 (1949)]. D. SHOENBERG

537.312.62

1019. The dependence of penetration depth of a magnetic field into a superconductor on the strength of a magnetic field. YU. V. SHARVIN. Letter in *Zh. Eksper. Teor. Fiz.*, **21**, 658 (*No.* 5, 1951) *In Russian.*

The variation of the temperature derivative of penetration depth of a magnetic field in pure tin with the strength of an applied magnetic field H is found to vary as $[1 + \alpha(H/H_c)^2]$ with $\alpha = 0{\cdot}28$ and independent of temperature. The method of experiment is not indicated. D. SHOENBERG

537.312.62

1020. Thermal conductivity of superconducting lead in the intermediate state. R. T. WEBBER AND D. A. SPOHR. Letter in *Phys. Rev.*, **84**, 384–5 (*Oct.* 15, 1951).

This is found to be higher than both in the superconductive and the normal state. The effect is more pronounced at low temperatures. H. LONDON

537.312.62 : 530.145.6

1021. Further remarks on the quantum theory of superconductivity. R. SCHACHENMEIER. *Z. Phys.*, **130**, 243–4 (*No.* 2, 1951) *In German.*

See Abstr. 4397 (1951). Author points out that the theory of Born and Cheng [Abstr. 3343–4 (1948), 4792 (1949)] is essentially the same as his own.

R. B. DINGLE

537.312.9 : 539.4.016.2

Change of resistivity of metals by cold-working. *See Abstr.* 1250–1

537.365

1022. Electrokinetic potentials of small particles by the sedimentation method. G. A. H. ELTON. Letter in *J. Chem. Phys.*, **19**, 1317 (*Oct.*, 1951).

An equation is derived for non-spherical particles suspended in an ionic liquid, allowing calculation of the electrokinetic potential involved. F. LACHMAN

ELECTRIC DISCHARGES 537.52

537.523.3

1023. Pre-breakdown discharges in d.c. positive point-to-plane corona. H. M. GAUNT AND J. D. CRAGGS. *Nature* [*Lond.*] **168**, 859–61 (*Nov.* 17, 1951).

Preliminary experiments on certain forms of corona discharge with photo-multiplier and photographic techniques are described. Attention is drawn to the diffuse pre-breakdown discharge. J. D. CRAGGS

537.523.4 : 537.523.5

1024. On the theory of mercury cathode spots. T. WASSERRAB. *Z. Phys.*, **130**, 311–20 (*No.* 3, 1951) *In German.*

This theoretical paper applies Mackeown's method, with modifications, and the Fowler–Nordheim field emission equation to a study of electrode spots of the type described by Froome [Abstr. 1776, 5864 (1950)] in which current densities appear to be $> 10^6$ A/cm^2. Theory is compared with expt., and it appears necessary to invoke even higher current densities than those measured optically by Froome. J. D. CRAGGS

537.523.5 : 621.315.618 : 621.3.015.5

1025. Observations on the electrical breakdown of gases at 2 800 Mc/s. W. A. PROWSE AND W. JASINSKI. *Proc. Instn Elect. Engrs, Pt IV*, **98**, 101–11 (*Oct.*, 1951) [*Monograph No.* 10].

For abstract see Abstr. 9508 (1951).

537.525

1026. The Schottky analogue in the production of the positive Joshi effect in hydrogen. H. J. ARNIKAR. *Indian J. Phys.*, **25**, 352–7 (*July*, 1951).

A lowering of the surface work function of a thermionic emitter in proportion to the square root of the intensity of the applied field, as suggested by Schottky, leads to a linear relation between log I and $\sqrt{X}$ or $\sqrt{V}$, where I is the thermionic current under the field X due to the potential V. This Schottky relation being known to be valid for both thermionic and photoelectric emission, the present work was carried out to understand its applicability in the production of the positive Joshi effect. Results for the positive Joshi effect ($+\Delta i$) in hydrogen for 5 different gas pressures show that log ($+\Delta i$) varies linearly as $\sqrt{V}$, thus substantiating Joshi's theory of the photoelectric origin of Δi. Results also suggest the co-occurrence of positive and negative Joshi effects ($+\Delta i$ and $-\Delta i$) above a limiting potential V_1. A.

537.525.5

1027. Heat dissipation at the electrodes of a short electric arc. L. H. GERMER. *Bell Syst. Tech. J.*, **30**, 933–44 (*Oct.* (I) 1951).

Platinum contacts are brought together 60 times a second, discharging on each closure a condenser of 0·01 mf capacity charged to 40 V. The heat flowing along each electrode is calculated from a temperature difference measured by thermocouples, and from this is determined the energy dissipated at each contact. If there is no arc on closure, the energy is the same on the two contacts, and is small. If there is an arc between the contacts before they touch, about 58% of its energy is dissipated upon the anode and about 42% upon the cathode. The distribution is the same in an arc between clean "inactive" electrodes and in the entirely different kind of arc occurring between carbonized "active" electrodes. A.

537.525.5

1028. Noble gas hot cathode diodes with negative arc drop. G. MEDICUS AND G. WEHNER. Letter in *J. Appl. Phys.*, **22**, 1389 (*Nov.*, 1951).

Describes how negative arc drops, i.e. discharge tubes acting as e.m.f's, can be obtained in l.p. hot-cathode arcs. It is necessary to obtain a low anode work function (e.g. with a Ba surface layer) and a high cathode work function (Ta cathode). J. D. CRAGGS

537.525.72

1029. The mechanism of the low-frequency electrodeless discharge in chlorine and the influence of irradiation. W. L. HARRIES AND A. VON ENGEL. *Proc. Phys. Soc.* [*Lond.*] *B*, **64**, 916–29 (*Oct.*, 1951).

The current flowing through a 50 c/s electrodeless discharge in a short cylindrical glass vessel with plane electrodes at the ends filled with chlorine at 5–50 mm Hg was investigated with an oscillograph. Once the discharge starts, electric charges collect on the inner surface of the vessel. Each current pulse consists of a series of avalanches which develop between small areas of the inner glass walls. One such area may discharge within a half cycle in several steps. The time variation of the applied field, the wall-charge field and the field in the gas are discussed and a new mechanism is developed which appears to apply to discharges between solid dielectrics. At room temperatures, Cl molecules form an adsorbed layer, several molecules thick, on the glass walls. Irradiation produces photo-dissociation of Cl_2, the atoms being effective in capturing electrons in this layer where slow electrons and many-body collisions are likely. This reduction of the number of secondary electrons reduces the pulse height. Adsorbed molecular gas layers also explain observations at higher temperatures. At higher voltages the interval between two successive pulses becomes so small that one pulse reduces the height of the following one. This is probably due to metastable Cl atoms and resonance radiation diffusing to the wall where they cause dissociation of molecules in the adsorbed layers, the Cl atoms capturing electrons as before. It also explains why at high voltages the effect of irradiation becomes insignificant. A.

537.525.8

1030. Investigations on the positive column of glow discharges in oxygen. I. R. SEELIGER AND A. WICHMANN. *Ann. Phys.* [*Lpz.*] **9**, 235–44 (*No.* 5, 1951) *In German.*

Describes two modes of the unstriated discharge in oxygen at $p \sim 1$–7 mm Hg which are characterized, for example, by different potential gradients. Spectroscopic observations are described, and data relating to the radial variations of current density are given.

J. D. CRAGGS

537.525.8

1031. Wall currents, ionic mobilities and ion temperatures in plasmas. F. WENZL. *Z. angew. Phys.*, **3**, 332–43 (*No.* 9, 1951) *In German.*

A detailed mathematical study of certain effects in low-pressure plasmas. The radial variation of average ion energy is studied in relation to other physical properties of the discharge. Wall effects and the investigation of the plasmas with probes in order to give, e.g., ion temperatures are also treated in detail. J. D. CRAGGS

537.525.9 : 537.562

1032. Oscillations of plasma and strata. G. V. GORDEEV. *Dokl. Akad. Nauk SSSR*, **79**, 771–4 (*No.* 5, 1951) *In Russian.*

The strata are considered as wave-group oscillations of potential, their velocity being identified with group velocity. For stationary strata, the distance between the strata peaks is compared with the length of almost monochromatic wave of the group or, for travelling strata, with the distance between the maxima of wave-groups. The theory is supported by experimental graphs and results with H_2, N_2 and Hg used as gases. Z. F. WOJNAR

537.525.9 : 537.562

1033. Oscillations in discharge as source of travelling layers. A. A. ZAĬTSEV. *Dokl. Akad. Nauk SSSR*, **79**, 779–81 (*No.* 5, 1951) *In Russian.*

Travelling layers are explained in terms of oscillatory processes in pure neon, neon and argon with molecular admixtures and air. Z. F. WOJNAR

537.527.4

1034. Condensed discharges in compressed gases. R. AUMONT. *C.R. Acad. Sci.* [*Paris*] **233**, 740–2 (*Oct.* 1, 1951) *In French.*

A note describing light emission effects from condensed sparks in gases at pressures of up to nearly 1 500 lb/in² (120 kg/cm²). J. D. CRAGGS

537.527.4

1035. The mechanism of spark breakdown in compressed gases. A. BOULLOUD. *C.R. Acad. Sci.* [*Paris*] **233**, 932–4 (*Oct.* 22, 1951) *In French.*

A brief discussion of breakdown processes in h.p. gases, involving space charge and field emission effects. The inadequacy of certain earlier theories is stressed.

J. D. CRAGGS

537.527.4

1036. On the production of very high temperatures in high power sparks. G. GLASER. *Z. Naturforsch.*, **6a**, 706–13 (*Nov.*, 1951) *In German.*

A description is given of certain characteristics of spark channels, using oscillatory condenser discharges with maximum currents varying up to about $2{\cdot}7\times10^3$ A. The period of oscillation varies from about 1–5 μsec. Spectroscopic studies of argon and hydrogen discharges were made, with results shown in the paper and a general discussion of various types of continuous spectra is given. The latter are particularly strong at the higher pressures (up to 17 atmospheres) used in this work. J. D. CRAGGS

X-RAYS 537.531

537.531

1037. The position of X-ray dosimetry. R. JAEGER. *Z. angew. Phys.*, **3**, 191–8 (*No.* 5, 1951) *In German.*

An account is given of all aspects of X-ray dosage. The use and limitations of the röntgen and the various energy units are shown. Fundamentals of the theory and design of ionization chambers and the measuring

instruments used in conjunction with them, are included. The physical and biological effects of radiations are discussed. In measurement and interpretation of radiation dosage, the need for the collaboration of chemistry, biology and physics is seen. D. V. MABBS

537.531 : 535.33.07

1038. A Geiger counter spectrometer for soft X-rays. J. L. ROGERS AND F. C. CHALKLIN. Letter in *Proc. Phys. Soc.* [*Lond.*] *A*, **64**, 935–6 (*Oct.*, 1951).

Using a Geiger counter behind a slit as "detector" in a grating spectrometer it is claimed that the accurate measurement of intensities as well as wavelengths in the soft X-ray region has been achieved. L. E. MUSSELL

537.531 : 535.338

1039. X-ray spectroscopy of the solid state. L. G. PARRATT AND E. L. JOSSEM. Letter in *Phys. Rev.*, **84**, 362 (*Oct.* 15, 1951).

Preliminary results with KCl and $K\beta$ radiation indicate that the radiative transition from the lowest atomic level below the occupied $3p$ band is 5 times as intense as that from the $3p$ band itself. For K, this level is 2·75 eV below the bottom of the $3p$ band, and for Cl, 3·8 eV below. The observations are briefly related to other spectroscopic work which may be successfully interpreted in terms of discrete atomic levels. A. J. KENNEDY

537.531 : 535.338

1040. On the influence of the nuclear magnetic moment on the width of X-ray lines. M. FRILLEY, B. G. GOKHALE AND M. VALADARES. *C.R. Acad. Sci.* [*Paris*] **233**, 1183–5 (*Nov.* 12, 1951) *In French.*

Theoretical considerations indicate that for Nb and In the separation of the h.f.s. components of K_α should be about 10% of the natural width and may cause an observable alteration of the structure of the lines. The width was measured, with a precision of 0·005 XU for the elements between $Z = 37$ and $Z = 50$. The theoretical predictions were not confirmed. L. PINCHERLE

537.531 : 535.343

1041. On the widths of K_α lines of elements Rb_{37} to Sn_{50}. B. G. GOKHALE. *C.R. Acad. Sci.* [*Paris*] **233**, 937–9 (*Oct.* 22, 1951) *In French.*

Results obtained with a curved-crystal spectrometer [Abstr. 5450 (1951)] show that the widths, expressed in energy units, vary as the cube of the atomic number. [See also Abstr. 5452 (1951)]. A. R. STOKES

537.531 : 535.43 : 548.73

1042. X-ray scattering by aggregates of bonded atoms. I. Analytical approximations in single-atom scattering. R. MCWEENY. *Acta Cryst.*, **4**, 513–19 (*Nov.*, 1951).

An approach is made to the problem of calculating atomic scattering factors for real atoms in which both inherent departures from sphericity and the effects of bonding are taken into account. An "effective" scattering factor for a bonded atom may be defined; the main contribution to this factor is the atomic scattering factor usually employed. Analytical approximations to atomic wave functions are used in order to obtain closed expressions for the scattering factors of atoms H to Ne. For those atoms which are non-spherical the scattering is dependent on atomic orientation; but it is easily described in terms of two "principal scattering factors." There are significant differences between the results of these calculations and those given many years ago by James and Brindley. A.

537.531 : 537.22

New developments in xeroradiography. *See Abstr.* 984

537.531 : 548.733

Suggested device for the production of a monochromatic divergent beam. *See Abstr.* 1328

537.531 : 778.33

Electronic amplification of the roentgenoscopic image. *See Abstr.* 1374

CATHODE RAYS . POSITIVE RAYS 537.533/.534

537.533

1043. The electron emission from metal surfaces after mechanical abrasion or treatment in a glow discharge. O. HAXEL, F. G. HOUTERMANS AND K. SEEGER. *Z. Phys.*, **130**, 109–23 (*No.* 1, 1951) *In German.*

An experimental method, using a Geiger counter, is described for the study of delayed emission of electrons from metal surfaces (Au) treated in various ways. Variations of emission with time and temp. are studied and the emission process is explained in terms of adsorption processes and the activation energies involved therein. J. D. CRAGGS

537.533 : 621.385.833 : 621.385.1.029.6

1044. Equivalent temperature of an electron beam M. E. HINES. Letter in *J. Appl. Phys.*, **22**, 1385–6 (*Nov.*, 1951).

A commentary on recent results by Parzen and Goldstein [Abstr. 4553 (1951)], showing that the effect of beam acceleration is to reduce the spread in longitudinal velocities by a large factor, when the gun is non-convergent, e.g. if Brillouin flow is established. Convergence at the gun and long drift-times both increase the effective beam temperature. A. H. W. BECK

537.533 : 621.385.833 : 621.385.1.029.6

1045. Comments on "Equivalent temperature of an electron beam." P. PARZEN. Letter in *J. Appl. Phys.*, **22**, 1386 (*Nov.*, 1951).

Reply to the preceding abstract, pointing out that electron-electron interactions, which are neglected, can be important. Experimental knowledge of the subject is not sufficiently advanced for a decision to be made. A. H. W. BECK

537.533.71

1046. On the reflection of electrons by metallic crystals. L. A. MACCOLL. *Bell Syst. Tech. J.*, **30**, 888–906 (*Oct.* (I) 1951).

Gives the results of some calculations of the reflection coefficient for electrons incident normally

on a plane face of a metallic crystal. The physical situation is treated as being one-dimensional; and it is assumed that the potential energy of an electron is a sinusoidal function of distance inside the crystal, and obeys the classical image force law outside the crystal. The reflection coefficient is computed as a function of the energy of the incident electrons, over the range from 0 to 20 eV, for a variety of values of the parameters which define the model of the crystal. A.

537.533.72

1047. The electrostatic lens as a high-resolution velocity filter. G. MÖLLENSTEDT AND O. RANG. *Z. angew. Phys.*, **3**, 187–9 (*No.* 5, 1951) *In German.*

It appears from Abstr. 2548 (1949) and 5038 (1950) that electrons of ~ 10 keV lose on inelastic scattering in thin films of matter $< \sim 10$ eV. Using a 3-electrode lens as a velocity filter [Abstr. 5038 (1950)] to exclude inelastically scattered electrons, improved contrast has been obtained. This is illustrated by electron micrographs with light-field and dark-field illumination. J. C. E. JENNINGS

537.533.72

1048. Graphical method for the approximate determination of trajectories in electrostatic lenses taking account of space charge. W. WALCHER. *Z. angew. Phys.*, **3**, 189–90 (*No.* 5, 1951) *In German.*

The applied field is treated as a series of potential steps, at each of which refraction occurs. In the intervening space free of applied field, the space charge alone is supposed to operate. Appropriate expressions for ray tracing are given. The method has been applied to lenses used with a high-intensity mass spectrograph. J. C. E. JENNINGS

537.533.72

1049. Gaussian characteristics of the electrostatic lens formed by two coaxial cylinders of equal diameter. P. GRIVET AND M. BERNARD. *C.R. Acad. Sci.* [*Paris*] **233**, 788–90 (*Oct.* 8, 1951) *In French.*

If the separation of the cylinders is infinitely thin, the axial potential is given in terms of a hyperbolic function of the axial co-ordinate [*Proc. Inst. Radio Engrs*, **28**, 418–20 (*Sept.*, 1940); Abstr. 163 B (1941) and 2810 (1942)]. By a suitable change of co-ordinate, the function Φ'/Φ may be made symmetric about its maximum; it is then approximately represented by Glaser's "bell" function. Formulae for the paraxial characteristics and a numerical table of focal lengths are given. J. C. E. JENNINGS

537.533.72

1050. On the non-paraxial theory of the elliptic electrostatic lens. E. REGENSTREIF. *C.R. Acad. Sci.* [*Paris*] **233**, 854–6 (*Oct.* 15, 1951) *In French.*

Extends the theory of Abstr. 7938 (1951) to "trans-gaussian" rays, in the sense defined in Abstr. 7298 (1950). Expressions are given both for lenses analogous to the cylindrical lens of light optics and for lenses slightly deformed from axial symmetry.

J. C. E. JENNINGS

537.533.72

1051. A new mathematical model of an electron lens. P. GRIVET. *C.R. Acad. Sci.* [*Paris*] **233**, 921–3 (*Oct.* 22, 1951) *In French.*

$H = H_0 \operatorname{sech}(z/b)$ describes the axial field of an unsaturated magnetic lens. The differential equation of paraxial rays may be solved in terms of Legendre functions, the order of which is a measure of the lens strength. The order is <1 if the strength of the lens is not sufficient to produce multiple foci. Expressions are given for the positions of the cardinal points when object and image are outside the strong field, and the case of high magnification is also discussed. Aberration is not considered. J. C. E. JENNINGS

537.533.72

1052. Calculation of the electron-optical characteristics of a special magnetic lens field without numerical ray tracing. F. LENZ. *Ann. Phys.* [*Lpz.*] **9**, 245–58 (*No.* 5, 1951) *In German.*

Same problem and same paraxial solution as in preceding abstract. Graphs are given of the paraxial properties and of the coefficients of spherical and chromatic aberration, over a wide range of lens strengths; the aberration coefficients refer to high magnification and the first axial intersection.

J. C. E. JENNINGS

537.533.72

1053. On designing a β-spectrograph by analogy with an optical one. V. M. KELMAN AND D. L. KAMINSKIĬ. *Zh. Eksper. Teor. Fiz.*, **21**, 555–61 (*No.* 4, 1951) *In Russian.*

It is pointed out that the compound β-spectroscope proposed in *Phil. Mag.*, **20**, 545–61 (*Oct.*, 1935) was not the analogue of an optical spectroscope, inasmuch as the first lens produced an image not at infinity but at the axis of the axially symmetric prism. Hence the dispersion of the final image was zero and such resolution as was achieved was due to the selective action of the second lens stop. For a compound β-spectroscope it is proposed to use the first lens as a collimator and to employ a parallel-sided prism, the whole system being symmetric about the centre line of the prism and each lens being rotation-free. The focusing in the median plane between the prism poles has only the aberration of the lenses. The ("z"-) focusing action of the prism in a surface normal to the median plane is discussed in the light of Khurgin, *Zh. Eksper. Teor. Fiz.*, **9**, 824 (1939). The system is stigmatic if for the z-focusing the prism is telescopic; for the limiting case of zero pole separation (i.e. uniform field within the || boundary) this corresponds to deviation of the beam by the prism through $\sim 98°$. An arrangement is also discussed in which the beam from the collimator enters the prism normally. J. C. E. JENNINGS

537.533.72

1054. On the possibility of correcting the magnetic lenses used in β-spectrometry. P. HUBERT. *C.R. Acad. Sci.* [*Paris*] **233**, 943–5 (*Oct.* 22, 1951) *In French.*

The diverging element, a short iron-free coil or a block of soft iron, is placed inside a solenoidal (Tricker) focuser, so that the 2 fields are superposed, in contrast to Abstr. 7013 (1951). It may be shown that intermediate ring focusing [Abstr. 3185 (1950)] may be produced in this way. A successful preliminary experimental check has been made, using the spectrometer described in Abstr. 324 (1952).

J. C. E. JENNINGS

537.533.73 : 539.4.016

1055. Electron transmission through thin metal sections with application to self-recovery in cold worked aluminium. R. D. HEIDENREICH. *Bell Syst. Tech. J.*, **30**, 867–87 (*Oct.* (I) 1951).

Features of the dynamical or wave mechanical theory of electron diffraction pertinent to the interpretation of electron images of crystalline materials are briefly discussed. It is shown that the type of image obtained depends upon the local bending of the crystal, the coherent crystal size and the state of internal strain. The absence of extinction contours seen in annealed Al is an indication of the presence of internal strains. New data concerning the effect of temperature on the polygon or domain size in cold-worked Al is presented. A.

537.533.74

1056. Measurement of the single scattering of fast electrons. H. REICH. *Z. Phys.*, **130**, 144–58 (*No.* 2, 1951) *In German.*

Formulae for single scattering intensities always require correction for multiple scattering. Formulae for this correction are discussed, and it is shown to depend greatly on which side of the scatterer the observations are made from, and on the inclination of the scatterer to the primary beam. Experiments with a 2 MeV electron beam confirmed the theory.

P. M. DAVIDSON

537.533.74

1057. The nuclear scattering of electrons and positrons in argon. A. F. HOWATSON AND J. R. ATKINSON. *Phil. Mag.*, **42**, 1136–45 (*Oct.*, 1951).

An automatic Wilson cloud chamber with specially constructed cameras was used to obtain data on the nuclear scattering in A of electrons from In^{114} and positrons from Cu^{62}. The tracks were analysed by the method of projected angles. The experimental angular scattering distribution was compared with calculated values based on Dirac's relativistic electron theory, the ratio expt./theory over the angular range 20°–90° being 1·02 for electrons and 0·92 for positrons. Similar calculations based on the semi-classical Rutherford scattering formula gave for the positron case a ratio expt./theory of 0·79. This is regarded as evidence in favour of the Dirac theory which gives a smaller scattering cross-section for positrons than for electrons. A.

537.533.74 : 537.531

1058. On the influence of electron diffusion on the angular distribution of X-ray bremsstrahlung. O. BLUNCK. *Ann. Phys.* [*Lpz.*] **9**, 373–80 (*No.* 6–7, 1951) *In German.*

An extension of S. Goudsmit and J. L. Saunderson's scattering theory [*Phys. Rev.*, **57**, 24–9 (*Jan.* 1, 1940); **58**, 36–42 (*July* 1, 1940)] leads to expressions for the angular distribution in which diffusion, back-diffusion and energy loss of the electrons in the anti-cathode are taken into account. Good agreement with G. Sesemann's experiments on Be at 90 and 150 kV [*Ann. Phy.* [*Lpz.*] **40**, 66 (*No.* 5, 1941)]. W. J. SWIATECKI

537.533.74/.534.74

1059. On the multiple scattering of charged particles. R. MERTENS. *C.R. Acad. Sci.* [*Paris*] **233**, 856–8 (*Oct.* 15, 1951) *In French.*

A formula is derived for calculating the angular distribution of charged particles emerging from a metal foil. W. J. SWIATECKI

537.533.75

1060. Fluctuations in the energy-loss of fast electrons in a proportional counter. P. ROTHWELL. *Proc. Phys. Soc.* [*Lond.*] *B*, **64**, 911–15 (*Oct.*, 1951).

The fluctuations in the energy lost by fast electrons over a fixed small fraction of their range have been studied by measuring the pulses the electrons produce in passing through a proportional counter. The energy loss distribution calculated theoretically by Landau is approximately Gaussian with a high-energy tail. The experimental distribution is in agreement with the theoretical on the high-energy side of the peak, but is wider than Landau predicts on the low-energy side; this discrepancy is greater in krypton than in argon. The experimental values of the most probable energy loss agree with the theoretical values. A.

537.533.8

1061. The structure of the emitter of Kubetskii's tube. S. M. FAĬNSHTEĬN AND L. I. TATARINOVA. *Dokl. Akad. Nauk, SSSR*, **79**, 435–8 (*No.* 3, 1951) *In Russian.*

A multi-phase system consisting of Cu_2O, Cu_2S, CuS and CuO, the main component being Cu_2O, has been detected by electron-diffraction methods in the emitter layer of Kubetskii's tube [*Proc. Inst. Radio Engrs*, **25**, 421–33 (*April*, 1937)], obtained by interaction between Cu deposited electrolytically on Ag and an aqueous solution of H_2S. In some specimens no Cu_2S could be detected. A more reliable method of obtaining a Cu_2S film consists in condensing (in air) an S layer on a monocrystal of NaCl, whereupon a layer of Cu is deposited on it by sublimation in a vacuum inside the electron diffraction apparatus. The interplane distances, Miller indices and intensities of the half-rings of the electronogram were for such a preparation almost identical with those for pure Cu_2S crystals. F. LACHMAN

537.534 : 621.319.33

1062. Energy doubling in d.c. accelerators. L. W. ALVAREZ. Note in *Rev. Sci. Instrum.*, **22**, 705–6 (*Sept.*, 1951).

The doubling is achieved by accelerating negative ions to a positively charged electrode, there stripping off two electrons by passing them through a thin foil, and accelerating the positively charged ions to ground potential. Practical details for the application of this method are discussed. J. HUGHES (R)

537.534.72

1063. On the neutralization of space-charge in positive ion beams. R. BERNAS AND J.-L. SARROUY. *C.R. Acad. Sci.* [*Paris*] **233**, 1092–4 (*Nov.* 5, 1951) *In French.*

The conditions under which electrons can be used to maintain the concentration of a beam of positive ions are investigated. The method has been applied to a magnetically focused isotope separating apparatus. A. H. W. BECK

537.534.74

1064. A note on the scattering of ions by molecules. V. MYERS. Letter in *J. Chem. Phys.*, **19**, 1425 (*Nov.*, 1951).

An estimate of the cross-section for the capture of

a ~ 1 eV proton by an H_2 molecule shows it to be $\sim 10^{-8}$ times the corresponding scattering cross-section. W. J. SWIATECKI

537.534.74 : 778.34

The surface loss correction for nuclear emulsions. *See Abstr.* 1375

537.534.74 : 778.34

1065. Observations on the multiple scattering of ionizing particles in photographic emulsions. IV. Protons of 336 MeV from the Berkeley cyclotron. Cosmic ray protons and mesons of 5 to 50 MeV. K. GOTTSTEIN AND J. H. MULVEY. *Phil. Mag.*, **42**, 1089–96 (*Oct.*, 1951).

For Pt III, see Abstr. 9231 (1951). Describes a determination of the scattering constant by measuring the multiple scattering of 336 MeV protons in Ilford G5 nuclear research emulsions which had been exposed in the 184 in Berkeley cyclotron. An account follows of an experimental determination of the relation between the scattering parameter and residual range for protons and mesons of the cosmic radiation. A second value of the scattering constant was found, using the range and energy of μ-mesons from the decay of π-mesons stopping in the emulsion. The result was used to obtain a range energy relation for protons of energy up to 200 MeV. A.

537.534.74 : 778.34

1066. Observations on the multiple scattering of ionizing particles in photographic emulsions. V. Scattering measurements on tracks of slow protons. M. G. K. MENON AND O. ROCHAT. *Phil. Mag.*, **42**, 1232–40 (*Nov.*, 1951).

The scattering constant has been determined by measurements of the multiple scattering along proton tracks ending in the emulsion. A value of $27{\cdot}8 \pm 0{\cdot}5$ has been obtained (for $\beta^2 \sim 0{\cdot}03$ and an average cell-size of 72 μ). A simple method involving the combined measurements of multiple scattering and residual range has been used to identify the particles. A parameter $P = 2{\cdot}37 \log \hat{\alpha}_{100\mu} + 1{\cdot}37 \log R$ was determined for each track (R being the range in microns and $\hat{\alpha}_{100\mu}$ the mean angle of multiple scattering—per 100 μ—measured along the faster half of the trajectory); P is a linear function of the logarithm of the mass of the particle. A scale of values of P has been calibrated experimentally using tracks of protons from artificial sources and those of σ-mesons. Using this method tracks of 83 protons have been identified amongst a group of 136 particles of charge $|e|$ ejected from cosmic-ray stars. The mean value of P for the 83 protons was found to be $4{\cdot}275 \pm 0{\cdot}013$. The resolution between π-mesons, protons, deuterons and tritons was found to be satisfactory. An appendix gives the coupling matrix calculated for the sagitta method, taking into account the loss of energy. A.

537.534.75

1067. Lithium range-energy curve determination in nuclear emulsions. P. CÜER AND J.-P. LONGCHAMP. *C.R. Acad. Sci.* [*Paris*] **233**, 939–41 (*Oct.* 22, 1951) *In French.*

537.534.75

1068. Range-energy relation of protons in the Ilford C2 emulsion. New experimental confirmation of a previous calculation. L. VIGNERON AND M. BOGAARDT. *C.R. Acad. Sci.* [*Paris*] **233**, 941–3 (*Oct.* 22, 1951). See Abstr. 3581 (1951).

537.534.8

1069. Mass dependence of electron liberation by isotopic ions. W. PLOCH. *Z. Phys.*, **130**, 174–95 (*No.* 2, 1951) *In German.*

Using a mass spectrograph and targets of Pt, Mb, Be and Cu, the secondary electron emission γ due to positive ions, and ionic reflection, were measured. Comparing two ion isotopes, γ for a given cathode was found to depend only on the ion velocity. In range of ion energies 600 eV to 6 000 eV, γ varied between 28% and 700%. Various theories are discussed, and it is concluded that the mechanism is the liberation of bound electrons from the target surface. F. LLEWELLYN JONES

537.534.8

1070. Electronic emission and reflection of ions from the metal surface. M. A. EREMEEV. *Dokl. Akad. Nauk, SSSR*, **79**, 775–7 (*No.* 5, 1951) *In Russian.*

Tantalum and tungsten, as collectors of secondary particles, were bombarded with a narrow ion beam of alkaline metals. Investigations were made at various temperatures, the targets being previously annealed up to 2 500°K. With very high temperatures, however, the targets became covered with adsorbed ions from the primary beam. The quantity of adsorbed particles, dependent on the evaporation of ions from the adsorbing layer on sudden overheating of the target, was determined by the magnitude of the galvanometer ballistic deflection. Experimental graphs of initial energies of ion beams for potassium and lithium are given. Z. F. WOJNAR

DISCHARGE TUBES . COUNTERS 537.54

537.542

1071. Calculation of the electrostatic fields in multi-wire anticoincidence counters. A. SEEGER. *Z. Naturforsch.*, **6a**, 688–94 (*Nov.*, 1951) *In German.*

This theoretical paper deals with the calculation of fields in, e.g., counters consisting of two coaxial cylinders between which are mounted several wires. A practical case is worked out. J. D. CRAGGS

537.542

1072. Experiments with multi-wire Geiger–Müller counters. H. JÜRGENSEN AND H. M. WEISS. *Z. Naturforsch.*, **6a**, 694–8 (*Nov.*, 1951) *In German.*

Describes certain characteristics of two forms of multi-wire counter, namely: (*a*) with wires mounted between parallel plates, and (*b*) with wires mounted between two co-axial cylinders. Reference is made to interaction effects between counters, and to certain consequences of the field distribution in the counter. The field distribution in the cylindrical counter is shown. J. D. CRAGGS

537.542

1073. The dissociation of ethyl-acetate in a Geiger–Müller counter. S. S. FRIEDLAND AND H. S. KATZENSTEIN. Letter in *Phys. Rev.*, **84**, 591 (*Nov.* 1, 1951).

Evidence is given to show that the CO_2 arising in

ethyl-acetate-filled counters which have been run for a long time, is a dissociation fragment and is not merely gas driven out from the walls. G. D. SIMS

537.542

1074. Discharge mechanism in argon counters. L. COLLI, U. FACCHINI AND E. GATTI. Letter in *Phys. Rev.*, **84**, 606 (*Nov.* 1, 1951).

The study of the fine structure of Geiger pulses, including the case of discharges spread along the whole counter wire, shows that discharge spread is due to photo-emission at the cathode. J. D. CRAGGS

537.542 : 539.16.08

Calibration of Geiger–Müller liquid counters by the radioactivity of potassium-40. *See Abstr.* 1179

537.542

1075. A determination of the electrical depth of an ionization chamber. G. P. BROUWER AND H. W. HOREMAN. *Physica*, **17**, 821–9 (*Sept.*, 1951).

The electric field in the neighbourhood of the entrance aperture of an ionization chamber is investigated by the method of the electrolytical trough. The electrical boundary, which is the plane where the axial field strength is zero, is determined for various geometrical configurations. The results prove that the divergence of the electrical boundary from the geometrical boundary may easily rise to an appreciable value, so that in accurate ionization measurements appropriate corrections for this divergence must be applied. A.

537.542

1076. Continuous purification of hydrogen in a large electron-pulse chamber. W. N. ENGLISH. *Rev. Sci. Instrum.*, **22**, 598–600 (*Aug.*, 1951).

A hot uranium purifier for hydrogen (or deuterium) has been constructed which will remove relatively large amounts of negative-ion-forming impurities such as O_2, Cl_2, H_2O, thus permitting electron pulse collection without any elaborate outgassing procedure. The method has been tested at 6 atmospheres hydrogen pressure by observing the pulse distribution from a Pu^{239} α-source in the chamber and plotting the "most-probable-pulse-amplitude" against purifying time. A "purifying time constant" of about two days was obtained. A.

537.542

1077. Photon recorder with antimony cathode. S. F. RODIONOV, E. N. PAVLOVA AND I. B. KARETNIKOVA. Letter in *Zh. Eksper. Teor. Fiz.*, **21**, 657–8 (*No.* 5, 1951) *In Russian.*

Gives counting properties and spectral response from 2 500 to 4 000 Å. E. P. GEORGE

537.542 : 539.165/.166

1078. Electron and gamma ray spectroscopy with scintillation detectors. R. C. BANNERMAN, G. M. LEWIS AND S. C. CURRAN. *Phil. Mag.*, **42**, 1097–1112 (*Oct.*); erratum, 1450 (*Dec.*, 1951).

An account is given of β- and γ-ray energy measurements. Various coincidence techniques appropriate to scintillation detectors are examined experimentally, and an investigation is made of the application of a single crystal, with source buried inside, to the elucidation and closer examination of decay schemes. Work is described on standard sources, on Hg^{203} and in some detail on La^{140}. New information is given for La^{140} concerning the 0·093 γ-ray, the high energy γ-ray and the decay scheme. A.

537.542 : 537.531 : 539.166

1079. The use of scintillation counters in the measurement of the energy of X-rays and low energy gamma-rays. S. A. E. JOHANSSON. *Ark. Fys.*, **3**, 533–45 (*Paper* 33, 1951).

Energy measurements are made on the low-energy gamma-rays from Ce^{141}, Os^{193} and Hg^{203} (10–300 keV) using a NaI–Tl crystal. A linear relation is found between pulse height and energy over this range. The counter is also applied to measurement of the continuous X-ray spectrum from a tungsten target for tube voltages of 75 and 100 keV. G. F. J. GARLICK

537.542 : 539.16.08

Determination of radioactivity by solution in a liquid scintillator. *See Abstr.* 1180

537.542

1080. Oscillographic method for recording pulse coincidences. V. V. VLADIMIRSKIĬ AND YU. V. TREBUKHOVSKIĬ. Letter in *Zh. Eksper. Teor. Fiz.*, **21**, 663–4 (*No.* 5, 1951) *In Russian.*

The pulses from individual counters are each fed into different points in a delay-line, the output of which is recorded oscillographically. A coincidence is recognized as a train of pulses. Partial coincidences may also be easily recognized. E. P. GEORGE

537.542 : 616–073.75

A method of making visible the distribution of activity in a source of ionizing radiation. *See Abstr.* 1372

537.542 : 621.318.572

1081. A method of coupling scale-of-two circuits. R. ASCOLI. Note in *Nuovo Cim.*, **8**, 584–5 (*Aug.*, 1951) *In Italian.*

A note on a modification to the usual resistance-capacity flip-flop circuits, which, using the recalculated component values (these are quoted with the full circuit), provides better stability and reliability of counting. A. J. KENNEDY

537.542

1082. On the wall-effect of a nucleus-counter. S. OHTA. *J. Met. Soc. Japan*, **28**, 161–7 (*May*, 1950) *In Japanese.*

A thin ($\frac{1}{4}$ mm) boundary layer in which no fog is formed exists along the surface of a cloud chamber, decreasing with increasing speed of expansion. It is attributed to thermal conduction from the wall. This is important, as nuclei in the layer near the wall escape observation and repeated expansions of the same sample of air are necessary.

METEOROLOGICAL ABSTRACTS

537.543 : 621.385.2

1083. Contribution to the problem of testing the materials used for anodes of vacuum diodes with oxide-coated cathodes. W. ESPE AND M. LUPÍNEK. *Slabopr. Obz.*, **12**, 26–34 (*Feb.*, 1951) *In Czech.*

A mathematical analysis is given of anode electron emission in diodes with oxide-coated cathodes and methods of measuring it are described. The theoretically obtained results are confirmed by experiment. On the basis of the results obtained

the methods of reducing reverse current in such valves are considered. Numerical results and graphs are given. E. GROS (R)

537.543 : 621.385.2

1084. Electron streams in a diode. F. GRAY. *Bell Syst. Tech. J.*, **30**, 830–54 (*Oct.* (I) 1951).

A general solution of the electron stream equations is developed for a parallel plane diode, under the assumption that the electron velocity is single-valued. This solution contains all particular solutions. It serves to unify the wave theory and the particle theory of electron flow, and it is an approximation for multi-velocity streams over a wide range of conditions. A.

537.543 : 621.385.832

1085. A fiftyfold momentary beam intensification for a high-voltage cold-cathode oscillograph. J. H. PARK. *J. Res. Nat. Bur. Stand.* [*Wash.*] **47**, 87–93 (*Aug.*, 1951).

Application of the method for increasing the recording speed of a high-voltage cathode-ray oscillograph is described. Oscillograms have been obtained in which the writing speed is about three-fourths the speed of light. The intensification is caused by superposing a steeply rising voltage pulse on the normal steady voltage across the electrodes of the discharge tube serving as the electron beam source. The voltage pulse momentarily disrupts equilibrium conditions in the discharge and produces an intense discharge that lasts for about 2 μsec. Measurements of the magnitude and duration of the superposed pulse and of the changes in discharge current have been made. A tentative explanation of the mechanism of intensification based on these measurements is given. A.

IONIZATION . THERMIONICS 537.56/.58

537.561

1086. The ionization potential of allyl radical. M. G. EVANS AND M. SZWARC. Letter in *J. Chem. Phys.*, **19**, 1322–3 (*Oct.*, 1951).

The procedure of determining the ionization potentials of radicals is illustrated by calculating the ionization potential of the allyl radical. F. LACHMAN

537.562 : 537.534.75

1087. On the loss of energy of charged particles in a strongly ionized medium (ionic plasma). B. KWAL. *J. Phys. Radium*, **12**, 805–10 (*Oct.*, 1951) *In French.*

This theoretical paper discusses the energy loss per unit path length suffered by various particles (electrons, protons or α-particles) when passing through ionized media. Cases are worked out numerically for particle energies varying from 100–5 000 eV, and the connection with certain astrophysical problems is discussed. J. D. CRAGGS

537.583

1088. The effect of ion bombardment on the emission from oxide coated cathodes. P. A. REDHEAD. *Canad. J. Phys.*, **29**, 362–9 (*Sept.*, 1951).

Some preliminary measurements of the decay of emission caused by ion bombardment of oxide-coated cathodes are presented. It is shown that cathode life increases with emission density if ion bombardment is prevented. A.

537.585

1089. An investigation of the emission of positive ions by triple salts of the type $Li_2O \cdot Al_2O_3 \cdot 4SiO_2$. G. COUCHET. *C.R. Acad. Sci.* [*Paris*] **233**, 1013–15 (*Oct.* 29, 1951) *In French.*

Methods of preparation of the salts and of measurement are described and results given for the variation of the thermionic current with temperature and field. E. P. WOHLFARTH

537.585

1090. Ionic image of an emissive anode. G. COUCHET, M. GAUZIT AND A. SEPTIER. *C.R. Acad. Sci.* [*Paris*] **233**, 1087–90 (*Nov.* 5, 1951) *In French.*

The anode is coated with a complex lithium-aluminium silicate which is heated by bombardment. This serves as object for an emission microscope, using the Li^+ ions. After heating for some time a lamellar structure appeared in the image, which is thought to be produced by the crystallographic orientation of the surface. A. H. W. BECK

COSMIC RAYS 537.591

537.591 : 539.152.1 : 539.16

1091. Nuclear physics and cosmic rays: a symposium at Heidelberg. R. M. STEFFEN. *Science*, **114**, 427–8 (*Oct.* 19, 1951).

A short report giving brief summaries of the papers presented and the names of the contributors. The papers are not available in full.

537.591.1

1092. Energy spectrum of the primary component of the cosmic radiation. YA. P. TERLETSKIĬ AND A. A. LOGUNOV. Letter in *Zh. Eksper. Teor. Fiz.*, **21**, 567–8 (*No.* 4, 1951) *In Russian.*

A general solution is given for Fermi's theory, based on an equation discussed previously by Einstein. E. P. GEORGE

537.591.1

1093. Some observations on the new unstable heavy particles. B. ROSSI, H. BRIDGE AND M. ANNIS. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **11**, 73–6 (*July–Aug.*, 1951) *In Italian.*

A photograph of a cloud chamber shows a charged V-particle arising directly in a nuclear process and later disintegrating with emission of a π-meson and a neutral particle. If the latter is a neutron, the mass of the V-particle must be included between 2 300 and 2 500 m; if it is a π^0-meson, between 850 and 1 100 m. In another photograph a V-particle is visible for a time of the order of 10^{-9} sec and thus its average life cannot be much less than 10^{-9} sec. L. PINCHERLE

537.591.1

1094. Associated penetrating particles of cosmic rays underground. H. J. J. BRADDICK, W. F. NASH AND A. W. WOLFENDALE. *Phil. Mag.*, **42**, 1277–88 (*Nov.*, 1951).

Two cloud chambers have been used at a depth underground equivalent to 26 m of water in a study

of the penetrating cosmic-ray particles. Pairs of associated penetrating particles have been observed originating in lead plates in the chamber and also entering it from above. It is considered that the process is one in which a μ-meson produces a penetrating secondary of mean energy $\sim 10^9$ eV, the penetrating secondary being either a μ-meson or a π-meson. The cross-section for the process is estimated to be about 5×10^{-29} cm^2 per nucleon for lead and of the same order of magnitude for sandstone. A.

537.591.15

1095. The formation of electro-nuclear showers in lead and carbon. S. A. Azimov and V. V. Guseva. *Zh. Eksper. Teor. Fiz.*, **21**, 569–73 (*No.* 5, 1951) *In Russian.*

Observations were made at 3 860 m altitude with a cloud chamber containing 2 C and 2 Pb plates interleaved. The chamber was covered with a large Pb absorber 20 cm thick. Two pictures are reproduced showing multi-cored cascade showers which are thought to arise most likely from π^0-mesons. The interaction-lengths of the penetrating particles in Pb and C are found to be 750 ± 260 and 205 ± 100 g.cm^{-2} respectively. The mean number of penetrating particles per shower capable of producing further nuclear showers is found to be $4{\cdot}5 \pm 1{\cdot}5$. This figure is the same for Pb and C. E. P. GEORGE

537.591.15

1096. Concerning the non-electromagnetic cascade process in cosmic ray showers. S. A. Azimov, M. I. Podgoretskiĭ, I. L. Rozental and K. P. Ryzhkova. *Zh. Eksper. Teor. Fiz.*, **21**, 574–80 (*No.* 5, 1951) *In Russian.*

Coincidences in several arrangements of heavily shielded counters were investigated at 4 700 m and 3 860 m altitude. The effect of large filters of C, Al and Pb over the apparatus was investigated. It was shown that in the non-electromagnetic showers there exist particles capable of generating secondary showers. E. P. GEORGE

537.591.15

1097. Penetrating showers produced in beryllium at sea-level. W. Y. Chang, G. del Castillo and L. Grodzins. Letter in *Phys. Rev.*, **84**, 582–4 (*Nov.* 1, 1951).

Penetrating showers from $4{\cdot}8$ g.cm^{-2} Be plates in a cloud chamber are found to show multiplicity and angular distribution not greatly different from those produced under similar conditions in Pb and C. J. G. WILSON

537.591.3

1098. The absorption of the photonic component of cosmic radiation in different materials. J. Clay and G. Klein. *Physica*, **17**, 858–64 (*Sept.*, 1951).

Absorption of high-energy photons in cosmic radiation was measured in Pb, Sn, Fe, Al, C and paraffin. It was possible to distinguish between instances where the photon produced one secondary electron (a Compton electron) and the instances of two or more secondary electrons (pair formation). The absorption coefficients are given for the rays producing either effect and in the former case the proportionality of this coefficient to Z was tested. Also the absorption of the secondary electrons was tested, whence the energy spectrum of the photons was estimated. The frequency of the different angles between the secondary electrons was measured and a frequency relation of the occurrence of 2, 3, 4 and 5 secondary particles was determined. A.

537.591.3

1099. Relationship of range and energy spectrum for penetrating cosmic-ray particles. H. D. Rathgeber. *Z. Naturforsch.*, **6a**, 598–602 (*Nov.*, 1951) *In German.*

Comparison of the magnetic deflection spectrum of penetrating particles and the corresponding range spectrum in water shows no abnormal loss of energy for momenta up to about 50 BeV. The rate of energy loss appears to be constant, $(2{\cdot}0 \pm 0{\cdot}1)$ MeV g^{-1} cm^2, up to at least 30 BeV. J. G. WILSON

537.591.3

1100. Absorption properties of the star-producing component of cosmic-rays. E. Schopper, K. H. Höcker and E. Rössle. *Z. Naturforsch.*, **6a**, 603–13 (*Nov.*, 1951) *In German.*

Emulsions were exposed embedded vertically in Pb, Fe and C absorbers at 2 950 m altitude. In Pb and Fe absorbers, a transition effect leading to maxima after $1{\cdot}2$ cm Pb and $4{\cdot}5$ cm Fe was identified as due to photons, and the relative importance of photons as a star-producing agency in the atmosphere is estimated. The magnitude of the observed effect is consistent with the accepted photon cross-section. Further maxima in ~ 20 cm Pb and ~ 20 cm of dense ($\rho \sim 2$) C are not explained. J. G. WILSON

537.591.5

1101. An abnormal increase in cosmic rays. A. Sittkus and D. Granz. *Z. Naturforsch.*, **6a**, 563–4 (*Oct.*, 1951) *In German.*

Note on an observation of an abnormal increase in cosmic rays over a period of 3 hours, and its correlation with solar, ionospheric and magnetic phenomena. W. J. G. BEYNON

537.591.5

1102. Cosmic rays from the sun, and the earth's magnetic field. A. Schlüter. *Z. Naturforsch.*, **6a**, 613–18 (*Nov.*, 1951) *In German.*

Orbits additional to those computed by Störmer have been determined for singly-charged particles approaching the earth with momenta in the significant range, $p \sim$ a few BeV/c. For solar particles, a maximum in middle latitudes at about 9 hr local time for positive particles, and a forbidden region near the poles, is predicted. The available evidence does not support these conclusions. J. G. WILSON

537.591.5

1103. A world-wide, daily variation in local time of the intensity of cosmic rays associated with weak, corpuscular-induced, magnetic storms. A. Ehmert and A. Sittkus. *Z. Naturforsch.*, **6a**, 618–22 (*Nov.*, 1951) *In German.*

A characteristic daily variation is derived for the period of disturbed magnetic field following solar eruptions, from records with ionization chambers and with counter telescopes. Comparison of measurements in Germany (Freiburg, Weissenau)

with others in Tokyo suggest that the effect is determined by local time. J. G. WILSON

537.591.5

1104. On the explanation of the daily variation of cosmic rays associated with slight magnetic disturbances. A. EHMERT. *Z. Naturforsch.*, **6a**, 622–6 (*Nov.*, 1951) *In German.*

These variations are confined to particles near the zenith, and the influence of only low-energy primaries is thus involved. It is suggested that the effects arise in the interaction of streams of charged particles from the sun with the earth's magnetic field, and they are shown, from experimental records, to be correlated with eruptive phenomena in the central meridian of the sun. J. G. WILSON

537.591.8

1105. Use of a radio link in the study of coincidences between impulses from counters separated by great distances. E. PICARD, A. ROGOZINSKI AND M. SURDIN. *J. Phys. Radium*, **12**, 854–9 (*Nov.*, 1951) *In French.*

537.591.8 : 539.172

1106. Multiple events produced in hydrogen by very high-energy cosmic-ray particles at an altitude of 90 000 feet. M. L. VIDALE AND M. SCHEIN. Letter in *Phys. Rev.*, **84**, 593 (*Nov.* 1, 1951).

A counter array selecting single ionizing particles traversing a Dewar flask, and recording the response of individual counters of an array below the flask, was flown for 4½ hours at 90 000 ft, with the flask filled with liquid H for about half the flight ($1{\cdot}4$ g.cm^{-2}). A significant number of multiple records are considered to be attributable to the H, and an estimate of the energy of incident protons which are able to produce multiple events is given. J. G. WILSON

537.591.8 : 539.172

1107. Nuclear transmutations produced by cosmic-ray particles of great energy. VI. Experimental results on meson production. U. CAMERINI, J. H. DAVIES, P. H. FOWLER, C. FRANZINETTI, H. MUIRHEAD, W. O. LOCK, D. H. PERKINS AND G. YEKUTIELI. *Phil. Mag.*, **42**, 1241–60 (*Nov.*, 1951).

For Pt V, see Abstr. 7353 (1950). An analysis has been made of the secondary particles ejected from nuclear disintegrations observed in electron-sensitive emulsions exposed to the cosmic radiation at 68 000 ft. Scattering and grain density measurements have been carried out on the tracks of 2 000 particles associated with these stars. In addition, the grain density and angular distribution of 3 070 shower particles and 1 508 "grey" tracks have been measured. For 200 stars, the energy of the primary particle which produced the disintegration was measured. A detailed analysis was made of such events. Single fast π-mesons of kinetic energy less than 1 BeV are found to interact strongly with nuclear matter. An estimate of the frequency of occurrence of neutral mesons was made from a consideration of the energy balance in stars of low multiplicity, n_s. A.

537.591.8 : 539.172

1108. Nuclear transmutations produced by cosmic ray particles of great energy. VII. Interpretation of the experimental results. U. CAMERINI, J. H. DAVIES, C. FRANZINETTI, W. O. LOCK, D. H. PERKINS AND G. YEKUTIELI. *Phil. Mag.*, **42**, 1261–76 (*Nov.*, 1951).

The observations reported in the preceding abstract are analysed and compared with the current theories of meson production. In making the analyses, account is taken of the interaction with the parent nucleus both of the recoil nucleons and the created mesons. It is found that the observations do not provide decisive evidence in favour of either plural or multiple meson production. The experimental results can be explained in terms of either the multiple theory with secondary generation of mesons, or the plural theory assuming many-body collisions. Other conclusions arising from the work are also discussed. A.

MAGNETISM 538

538.11

1109. The problem of Maxwell stresses. R. GANS. *Ann. Phys.* [*Lpz.*] **9**, 337–40 (*No.* 6–7, 1951) *In German.*

Criticizes a paper by Sommerfeld and Bopp [Abstr. 1920 (1951)]. The magnetostatic force density is shown to equal $\mathbf{H} \cdot (\nabla \cdot \mu\mathbf{H}) - \frac{1}{2}\mathrm{H}^2 \cdot \nabla\mu$ and the components of the stress tensor $\mathrm{T}_{xx} = \frac{1}{2}\mu(\mathrm{H}_x^2 - \mathrm{H}_y^2 - \mathrm{H}_z)$, $\mathrm{T}_{xy} = \mathrm{T}_{yx} = \mu\mathrm{H}_x\mathrm{H}_y$. The torque on the magnet is calculated generally and an explicit relation is given for a prolate spheroidal bar magnet, magnetized along the polar axis. E. P. WOHLFARTH

538.114

1110. Theory of antiferromagnetism and antiferromagnetic resonance absorption. I. T. NAGAMIYA. *Progr. Theor. Phys.*, **6**, 342–9 (*May–June*, 1951).

It is pointed out that the anisotropy energy is of primary importance in the theory of antiferromagnetism. The formula for the susceptibility $\chi = (\chi_{\parallel} + 2\chi_{\perp})/3$, which follows in van Vleck's theory from a rather arbitrary assumption that the parallel and perpendicular domains are distributed with a ratio 1 : 2, can only be justified by inclusion of anisotropy energy. A formula for the dependency of the susceptibility upon external magnetic field is derived, and it will be shown that the field-dependent part varies proportional to the square of the intensity of the magnetic field, and inversely proportional to the anisotropy constant. A.

538.114

1111. Theory of antiferromagnetism and antiferromagnetic resonance absorption. II. T. NAGAMIYA. *Progr. Theor. Phys.*, **6**, 350–5 (*May–June*, 1951).

Resonance absorption of microwaves by antiferromagnetic substances is discussed by extending Kittel's theory of ferromagnetic resonance absorption. Assuming the model proposed in Part I, it follows that there appears a broad resonance absorption peak below the Curie point for a powder specimen, qualitatively similar to that observed by Trounson and others for Cr_2O_3, although the observed ordinary paramagnetic resonance cannot be predicted, probably due to an over-simplified assumption for the equation of motion. A.

538.213/.221

1112. The investigation of ferromagnetic resonance by means of the complex permeability diagram. B. PISTOULET. *C.R. Acad. Sci.* [*Paris*] **233**, 1015–17 (*Oct.* 29, 1951) *In French.*

A graphical method for representing the high frequency permeability in the complex plane is described and applications of the method to measured values for ferromagnetic powders are indicated.

E. P. WOHLFARTH

538.22

1113. Magnetic properties of antimony at low temperatures. V. I. VERKIN, B. G. LAZAREV AND N. S. RUDENKO. Letter in *Zh. Eksper. Teor. Fiz.*, **21**, 658 (*No.* 5, 1951) *In Russian.*

The de Haas–van Alphen effect has been found in antimony. The effect is slight at 4·2°K but more pronounced at 2°K. The period is 250 gauss at a field of 14 000 gauss. See also Abstr. 6326 (1951).

D. SHOENBERG

538.221

1114. Note on the magnetic properties of the FeS_n system. K. YOSIDA. *Progr. Theor. Phys.*, **6**, 356–65 (*May–June*, 1951).

The ferromagnetic properties of the FeS_n system are interpreted as an imperfectly compensated antiferromagnetism, or ferrimagnetism as it is called by L. Néel. A special case of $n = 1$, namely the substance $FeS_{1\cdot00}$ is regarded as an antiferromagnetic material. In FeS_n, Fe^{3+} ions appear when $n > 1$, and its ferromagnetism is explained by assuming that these Fe^{3+} ions are preferably situated on only one of the two sublattices which correspond to + and − spin orientations respectively. A.

538.221

1115. The investigation of antiferromagnetism. Thermomagnetic investigation of cobalt and nickel oxide. C. HENRY LA BLANCHETAIS. *J. Phys. Radium*, **12**, 765–71 (*Oct.*, 1951) *In French.*

See also Abstr. 6332 (1951). The transformation temperature T_c for CoO is 292°K. Above T_c the substance is paramagnetic, but the Curie–Weiss law is only obeyed above 460°K, with $p_B = 4\cdot96$ and $\theta = -280$°K. For NiO $T_c = 647$°K, but the maximum in the χ–T curve is very flat and the curves are quite strongly field-dependent, indicating the presence of a ferromagnetic impurity in the specimens. No conclusions are drawn as to the magnetic behaviour of NiO for $T > T_c$. E. P. WOHLFARTH

538.221 : 666

1116. Magnetic studies on glasses containing iron, in relation to their colour and constitution. H. MOORE AND S. KUMAR. *J. Soc. Glass Techn.*, **35**, 58T–92T (*April*, 1951).

From the magnetic susceptibilities of the glasses the mass susceptibility of the iron at 25° was determined and the conclusions drawn that iron can exist in glasses as: (1) ferrous iron, producing a blue colour; (2) ferric iron, in the form of colloidal ferric oxide, giving a yellow or amber colour; (3) ferroso-ferric iron, in the form of colloidal ferroso-ferric oxide, which contributes a grey colour; and (4) iron which is linked into the glass structure in a form which contributes no colour. The low mass susceptibility of the colourless iron suggests that the iron in this form is linked into the structure by 4 bonds, probably as FeO_4 tetrahedra. This cannot, however, be regarded as definitely established without additional experimental evidence. A.

538.222

1117. Paramagnetic resonance at very low temperatures in hydrated praseodymium chloride. C. F. DAVIS, A. F. KIP AND R. MALVANO. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **11**, 77–9 (*July–Aug.*, 1951) *In Italian.*

Two lines were observed whose position and shape varied with the orientation of the crystal. Results may be interpreted by assuming an axial electric field. The h.f.s. of the lines shows that the nuclear spin is $\frac{5}{2}$.

L. PINCHERLE

538.222

1118. On the magnetization and the paramagnetic rotatory power of α nickel sulphate hexahydrate. J. BECQUEREL, J. VAN DEN HEUVEL AND H. A. KRAMERS. *Physica*, **17**, 717–36 (*Aug.*, 1951) *In French.*

The paramagnetic susceptibility of $\alpha NiSO_4 . 6H_2O$ at temperatures between 1·3°K and 300°K has been deduced from measurements of the paramagnetic rotatory power. At temperatures above that of liquid air the results are in agreement with the theory that the paramagnetism is due to a binding between two of the three levels into which the ground state of Ni^{++} splits in the presence of a molecular field. This model is too simplified to account for the phenomena at lower temperatures. A. E. DE BARR

538.222

1119. The paramagnetic rotation of nickel sulphate α-hexahydrate at low temperatures (experimental results). M. LÉVY AND J. VAN DEN HANDEL. *Physica*, **17**, 737–47 (*Aug.*, 1951).

In connection with the work of M. Lévy [Abstr. 7924 (1950)] on the natural optical activity of $NiSO_4 . 6H_2O$, the influence of a magnetic field on this activity was measured. The work described in the preceding abstract was also extended. It was found that the dispersion ratios $V(\lambda_1)/V(\lambda_2)$ depend on temperature and also that even at room temperature ρ/H_a is not a constant, but is slightly dependent on the field strength. $(1/V)[(\rho/H_a) - V]$ seems to be a quadratic function of H_a. The Verdet constant perpendicular to the axis was also measured. The accuracy is not very great, but the result is in very good agreement with predictions from the theory of Schlapp and Penney. A.

538.222

1120. Dipole-dipole interaction in the rare-earth ethylsulphates. B. BLEANEY, R. J. ELLIOTT AND H. E. D. SCOVIL. Letter in *Proc. Phys. Soc.* [*Lond.*] *A*, **64**, 933–5 (*Oct.*, 1951).

A triplet structure in the paramagnetic resonance spectrum of neodymium ethylsulphate at low temperature is well accounted for by dipole-dipole interaction with the next neodymium ions. L. PINCHERLE

538.222

1121. Paramagnetic resonance in trivalent molybdenum. S. RAMASESHAN AND G. SURYAN. Letter in *Phys. Rev.*, **84**, 593 (*Nov.* 1, 1951).

Sharp resonances are obtained using double salts,

which lead to g-values of 1·76 for the ions. The sharpness may be due to exchange interaction as in Cu^{+++} salts. G. J. KYNCH

538.222 : 537.531

1122. Effects of X-rays upon plastics. Paramagnetic resonance. E. E. SCHNEIDER, M. J. DAY AND G. STEIN. *Nature* [*Lond.*] **168,** 645 (*Oct.* 13, 1951).

After irradiation with X-rays, both coloured and clear Perspex show sharp paramagnetic resonance spectra, consisting of a central peak surrounded by satellites. In the coloured Perspex the peak corresponds to the free spin g-factor, but in the clear it is shifted downfield by 20 gauss. The fine structure is a measure of the regularities in the plastic structure. See also Abstr. 890 (1952). C. TURNER

ELECTROMAGNETISM . ELECTRODYNAMICS 538.3/.5

538.3

1123. Properties of the electromagnetic field of helices. E. ROUBINE. *C.R. Acad. Sci.* [*Paris*] **233,** 1174–6 (*Nov.* 12, 1951) *In French.*

See also Abstr. 8052 (1951).

ELECTROMAGNETIC WAVES AND OSCILLATORS 538.56

538.56 : 535.34

1124. The extinction of e.m. waves. W. BRAUNBEK. *Phys. Bl.,* **7,** 197–204 (*No.* 5, 1951) *In German.*

It is suggested that at every frequency there exists a maximum value for the extinction coefficient, of the order of that observed in metals. L. PINCHERLE

538.565 : 536.46

1125. A cavity resonator method for electron concentration in flames. T. M. SUGDEN AND B. A. THRUSH. Letter in *Nature* [*Lond.*] **168,** 703–4 (*Oct.* 20, 1951).

538.566 : 621.385.1.029.6

1126. On longitudinal and transverse electric waves in uniformly moving plasma. W. O. SCHUMANN. *Z. angew. Phys.,* **3,** 178–81 (*No.* 5, 1951) *In German.*

If electromagnetic waves are propagated in moving plasma in the same direction as that of the motion, two different types of wave may exist. When there is space charge present and an electric component directed similarly to the plasma velocity, the wave is purely longitudinal. The second type occurs in the absence of space charge and with transverse field components or with a longitudinal electric component. The first type has already been described by the author [*Naturwissenschaften,* **51,** 140 (1943)]. The second type is the characteristic transverse wave found in moving plasma but may also be found with a longitudinal component at the lateral boundary of the plasma. The method employed here is to examine the wave properties in still plasma and then apply a relativistic transformation. A classical form of transformation may only be applied when not only is the electron-cloud velocity small compared with that of light, but also the phase velocity of the wave in the still system is sufficiently small. S. C. DUNN (R)

538.566 : 531.717

The diffraction of electromagnetic waves on a dielectric cylinder as a method of thickness measurement for quartz thread. *See Abstr.* 795

538.566

1127. Cylindrical surface wave guides. H. M. SCHMIDT. *Z. angew. Phys.,* **3,** 272–9 (*No.* 7, 1951) *In German.*

A summary of the most important theoretical and experimental results so far achieved. References.

J. G. OLDROYD

538.566 : 621.392.26

1128. The geometrical sense of the conditions of the existence of transverse electric and magnetic fields in curvilinear coordinate systems. M. L. LEVIN. *Dokl. Akad. Nauk SSSR,* **79,** 589–90 (*No.* 4, 1951) *In Russian.*

The condition for the absence of a w-component of the electric and magnetic vector of a field expressed in orthogonal curvilinear co-ordinates u, v, w, may be given the form $e_w = 1$; $\partial/\partial w(e_u/e_v) = 0$, where e_u, e_v, e_w are the metric coefficients. The first of these conditions, expressing the equivalence of all surfaces w = const., leads to the inference that the orthogonal w-curves are straight lines. Operating with these conceptions and using the second condition and Dupin's theorem, it is found that all the points of the w-surfaces must be umbilical points, which is only true for spheres and planes. It is therefore unnecessary to devise a general theory of waveguides of proportionally varying cross-section where cylindrical and conical guides are considered only as special cases illustrating the general theory. B. F. KRAUS

538.566 : 621.392.26 : 621.396.671

1129. Radiation from an aerial in a rectangular waveguide. M. JESSEL. *C.R. Acad. Sci.* [*Paris*] **233,** 783–5 (*Oct.* 8, 1951) *In French.*

Describes a method for calculating the radiation pattern of an aerial in a rectangular waveguide, by means of images, when the radiation pattern in free space is known. The method can also be applied to the problem of slots in rectangular guides. G. D. SIMS

538.566.2

1130. Microwave propagation in the optical range. O. F. PERERS, B. K. E. STJERNBERG AND S. K. H. FORSGREN. *Trans Chalmers Univ. Techn.* [*Gothenburg*] 19 *pp.* (*No.* 108, 1951).

Report of tropospheric propagation experiments using 1–10 cm radar equipment over distances of 6 and 13 km. Some examples of field-strength fluctuations and associated meteorological changes are briefly discussed. W. J. G. BEYNON

538.566.2 : 621.396.11

1131. Propagation of very-high-frequency radio waves. E. H. JONES. Letter in *Nature* [*Lond.*] **168,** 870–1 (*Nov.* 17, 1951).

Note on some field strength measurements on frequencies of 280 and 387 Mc/s over distances up to 250 miles, the transmitter being airborne at 40 000 ft

and the receiver near the ground. Some discrepancies between observed and calculated values are noted.
W. J. G. BEYNON

538.566.2 : 621.396.812

1132. A note on the "Attenuation of radio signals caused by scattering." J. B. SMYTH AND C. P. HUBBARD. Letter in *J. Appl. Phys.*, **22**, 1386 (*Nov.*, 1951).

It is proposed to modify the original [Abstr. 5611 (1951)] to include short wavelengths (propagation of light) by considering only back-scattering, i.e. integrating only over the hemisphere backward to the direction of propagation. An expression for the back-scattered power is obtained and a plot included.
A. H. W. BECK

538.566.2 : 621.396.812

1133. Reply to J. B. Smyth and C. P. Hubbard. A. H. LAGRONE. Letter in *J. Appl. Phys.*, **22**, 1386 (*Nov.*, 1591).

The criticisms made in the preceding abstract are held to be invalid because the effective area of a distant receiver would be so small compared with the principal area over which scattering occurred that essentially all the scattered power would be lost.
A. H. W. BECK

538.566.3 : 550.385

1134. Polar blackouts recorded at the Kiruna observatory. R. LINDQUIST. *Trans Chalmers Univ. Techn.* [*Gothenburg*] 24 *pp.* (*No.* 103, 1951).

A study is made of the correlation between ionospheric and magnetic disturbances for the period 1948–50.
W. J. G. BEYNON

538.566.3 : 621.396.11

1135. Spectral representation of received signals and the ionosphere. A. SPORK. *Öst. Z. Telegr.-Teleph.-Funk-Fernsehtech.* [*ÖTF*] **5**, 100–10 (*July–Aug.*, 1951) *In German.*

The wavelength distribution of received field strengths for all stations in the medium- and long-wave band and their variations with time are displayed in a form similar to optical absorption spectra. The results are discussed in terms of variations in the principal ionospheric layers. "Mögel–Dellinger" effects and the influence of auroral phenomena are also briefly considered.
W. J. G. BEYNON

538.566.3 : 621.396.11

1136. On the reflection of broadcast waves in the ionosphere. W. DIEMINGER. *Tech. Hausmitt. NordwDtsch. Rdfunks.*, **3**, 146–50 (*Sept.*, 1951) *In German.*

A brief non-mathematical survey of the results of ionospheric research.
J. M. HOUGH (R)

538.569.3

1137. A new diagram for the determination of the dielectric constant and the absorption of centimetre waves. S. LE MONTAGNER AND J. LE BOT. *C.R. Acad. Sci.* [*Paris*] **233**, 1017–19 (*Oct.* 29, 1951) *In French.*

Determination of the complex dielectric constant for guided waves necessitates the graphical solution of the equation $Z = z^{-1} \tanh z$. A new solution diagram, intermediate between those of Benoît and Roberts–Von Hippel, is described, which is claimed to be more accurate than that of the latter and which reduces the calculation required in the determination of ε' and ε''.
G. D. SIMS

538.569.3 : 537.226.2 : 535.343–14

Dielectric properties at centimetre wavelengths. *See Abstr.* 882–4

MAGNETIC EFFECTS 538.6

538.65 : 534.21

1138. Effect of a magnetic field on the propagation of sound waves in a ferromagnetic material. J. DE KLERK. Letter in *Nature* [*Lond.*] **168**, 963–4 (*Dec.* 1, 1951).

Experiments are described on the influence of transverse and longitudinal magnetic fields on the velocity of propagation and the attenuation of h.f. longitudinal acoustic waves in ferromagnetic rods. The attenuation coefficient μ reaches a minimum as magnetic saturation is reached, the curve $\mu_0 - \mu_H$ against H having the form of an initial magnetization curve.
E. P. WOHLFARTH

538.653 : 539.389.2

1139. Magnetic properties, internal strains and the Bauschinger effect in metals. N. H. POLAKOWSKI. Letter in *Nature* [*Lond.*] **168**, 838 (*Nov.* 10, 1951).

An interpretation is given of the findings of Wilson [Abstr. 7104 (1951)] that the intensity of magnetization of a high carbon steel increases on plastic deformation but decreases again on applying a relatively small plastic strain in the opposite direction. The discussion is based on the suggestion that during the process some latent strain energy is induced in the metal which will affect the mechanical hardness as well as the magnetic properties.
E. P. WOHLFARTH

MOLECULAR AND ATOMIC STRUCTURE 539.1

THEORY OF SOLID STATE 539.11

539.11

1140. Statistics of kagomé lattice. I. SYÓZI. *Progr. Theor. Phys.*, **6**, 306–8 (*May–June*, 1951).

The transition temperature of the "kagomé" lattice with $Z = 4$ is obtained and compared with that of the square lattice.
A.

539.11

1141. A new calculation of the cohesive energy of metallic beryllium. B. DONOVAN. *Nature* [*Lond.*] **168**, 836–7 (*Nov.* 10, 1951).

Results obtained by a method similar to that of Raimes [Abstr. 7400 (1950)] are presented. The agreement with experiment is good in the case of the lattice constant, cohesive energy and compressibility, and is poor in the case of the work function.
R. S. PEASE

539.11 : 539.32 : 548.7

1142. Elastic constants of alkali halide crystals. K. S. KRISHNAN AND S. K. ROY. Letter in *Nature* [*Lond.*] **168,** 869–70 (*Nov.* 17); addendum, 983 (*Dec.* 8, 1951).

A simple Born model of NaCl and CsCl is used to calculate the contribution of the electrostatic and repulsive interactions of the ions to the elastic constants. J. E. CAFFYN

MOLECULAR STRUCTURE 539.13

539.13

1143. On an additional condition for the co-ordinates of a central force system and the rules of their use in equations and matrices. P. G. MASLOV. *Dokl. Akad. Nauk SSSR,* **79,** 767–70 (*No.* 5, 1951) *In Russian.*

In a valence force field for an n-atomic molecule with m valence co-ordinates and $(n-m)$ angular co-ordinates x_{ik}, the latter satisfy an additional relation $\Sigma x_{ik} = 0$. A corresponding relation between the co-ordinates in a central force system and the equations of motion is derived. J. JACOBS

539.13

1144. A nuclear magnetic parameter related to electron distribution in molecules. H. S. GUTOWSKY, D. W. MCCALL, B. R. MCGARVEY AND L. H. MEYER. Letter in *J. Chem. Phys.*, **19,** 1328–9 (*Oct.*, 1951).

The electron distribution in substituted benzenes is investigated by measuring the effect of the substituent group on the F^{19} magnetic shielding in the appropriate fluorobenzene. Values of the nuclear magnetic shielding parameter δ, which is defined as $10^5 \times (H_r - H_c)/H_r$ (H_c is the applied magnetic field required for F^{19} resonance in the substituted fluorobenzene at a fixed frequency and H_r is the magnetic field required for fluorobenzene), are given for 10 substituted fluorobenzenes. A systematic correlation is obtained between δ and values of Hammett's σ [*Physical Organic Chemistry*, New York, *p.* 184 (1940)]. W. R. ANGUS

539.13

1145. Coupling among nuclear magnetic dipoles in molecules. H. S. GUTOWSKY, D. W. MCCALL AND C. P. SLICHTER. Letter in *Phys. Rev.*, **84,** 589 (*Nov.* 1, 1951).

The splitting into multiple nuclear magnetic resonance lines in liquids is attributed to a 2nd-order interaction between nuclear magnetic moments and an internal molecular magnetic field. J. JACOBS

539.13 : 541.64

1146. The configuration of real polymer chains. T. B. GRIMLEY. Letter in *J. Chem. Phys.*, **19,** 1315 (*Oct.*, 1951).

Polemical. The mathematical treatment proposed by Flory [*J. Chem. Phys.*, **17,** 303 (1949)] for the volume effect in coiling long-chain molecules is claimed to be unsound, the factor f not having the physical significance assumed by Flory. W. R. ANGUS

539.13 : 541.64

1147. The configuration of real polymer chains. P. J. FLORY. Letter in *J. Chem. Phys.*, **19,** 1315–16 (*Oct.*, 1951).

An answer to the preceding abstract. W. R. ANGUS

539.132

1148. The shift in isotope frequencies in equilibrium of hydrogen cyanide-acetic acid solution. E. W. BECKER AND W. VOGELL. *Z. Phys.*, **130,** 129–38 (*No.* 2, 1951) *In German.*

The shift in the ratio of C and N isotopes is measured between gaseous HCN and HCN in CH_3COOH solution. As the shift ratios for C and N differ from 1 ($1{\cdot}74 \pm 0{\cdot}3$) the influence of the solution lattice on the inner vibrations of the HCN molecules is significant, rather than the lattice vibrations of the solution. Equilibrium constants for C^{13} and N^{15} exchange are $\alpha(C^{13}) = 1{\cdot}0019 \pm 0{\cdot}0006$, $\alpha(N^{15}) = 1{\cdot}0011 \pm 0{\cdot}0005$. J. JACOBS

539.132

1149. Calculation of the ground state of the H_2 molecule. (Comments on a technique given by A. v. Mohrenstein.) H. PREUSS. *Z. Phys.*, **130,** 239–41 (*No.* 2, 1951) *In German.*

Mohrenstein's [Abstr. 1214 (1951)] procedure was tested by applying the Ritz technique, and is shown to lead to incorrect bond energies and internuclear distances. J. JACOBS

539.132

1150. Calculation of the H_2 molecule. (Reply to the above paper by H. Preuss.) A. v. MOHRENSTEIN. *Z. Phys.*, **130,** 242 (*No.* 2, 1951) *In German.*

See preceding abstract. The Heitler–London method oversimplifies the symmetry properties of the molecule, and is inadequate for higher approximations. It is asserted that the Mohrenstein technique is free from these shortcomings. J. JACOBS

539.132

1151. On the problem of calculating the principal polarizabilities of the hydrogen molecule. T. NEUGEBAUER. *Ann. Phys.* [*Lpz.*] **9,** 325–36 (*No.* 6–7, 1951) *In German.*

Quantum mechanical perturbation theory and Silberstein's theory describe two different physical causes of anisotropy, both of which should be taken into account. The two theories agree provided the rotational frequency is small compared with electronic frequencies. This is not true for H, hence anisotropy determined from experimental data is too small. J. JACOBS

539.132

1152. On the oscillator strength of the $x^2\Pi$–$A^2\Delta$ transition of the CH radicle. D. R. BATES. Letter in *Proc. Phys. Soc.* [*Lond.*] *A,* **64,** 936–7 (*Oct.*, 1951).

Accurate knowledge of the f-value is still lacking, as all values quoted hitherto rest on one experimental determination, and quantum-mechanical results have been used with some empirical correction factor. J. JACOBS

539.132

1153. Calculation of electric dipole moments of some heterocyclics. P.-O. LÖWDIN. Letter in *J. Chem. Phys.*, **19,** 1323–4 (*Oct.*, 1951).

The contribution to the dipole moments from

mobile π-electrons of conjugated ring systems obeys vector addition. J. JACOBS

539.132

1154. On the analytical expression of quantities in the theoretical chemistry of linear and cyclic alternate chains. R. GOUARNÉ. *C.R. Acad. Sci.* [*Paris*] **233,** 1037–9 (*Oct.* 29, 1951) *In French.*

The system of numbering distinguishes between $n/2$ odd or even. Accordingly 2 or 4 parameters are required in energy calculations. Bond orders and free valences are evaluated for $C_{26}H_{16}$, $C_{30}H_{18}$, $C_{34}H_{20}$. J. JACOBS

539.132

1155. The lower excited states of carbon dioxide. J. F. MULLIGAN. Letter in *J. Chem. Phys.*, **19,** 1428–9 (*Nov.*, 1951).

Roothaan's LCAO self-consistent field technique has been used. As experimental data are inconclusive no unique correlation with experimental results can be made. J. JACOBS

539.132

1156. On the three- and four-center integrals in molecular quantum mechanics. K. RÜDENBERG. Letter in *J. Chem. Phys.*, **19,** 1433–4 (*Nov.*, 1951).

A relation is established between 3- and 4-centre repulsion integrals and 2-centre Coulomb and overlap integrals. J. JACOBS

539.132

1157. Quadrupole resonance of Cl^{35} and Cl^{37} in p-$C_6H_4Cl_2$. M. BUYLE-BODIN AND D. DAUTREPPE. *C.R. Acad. Sci.* [*Paris*] **233,** 1101–3 (*Nov.* 5, 1951) *In French.*

The resonance is near to that of C_6H_5Cl, and thus the interaction between the two Cl-atoms is small. The resonance was detected at ordinary temperatures in solid specimens. The width of the line could be accounted for by spin-spin interaction. At liquid-H temperatures the Cl^{35} line becomes double, perhaps due to a fine structure. L. PINCHERLE

539.132

1158. On practical rules of enumerating molecular integrals entering the calculation of configuration interaction. O. CHALVET, R. DAUDEL, M. ROUX, C. SÁNDORFY AND C. VROELANT. *C.R. Acad. Sci.* [*Paris*] **233,** 1277–9 (*Nov.* 19, 1951) *In French.*

The off-diagonal terms of the interaction matrix are expressed in integrals over molecular orbitals. J. JACOBS

539.133

1159. Energy of dissociation of cyanogen. P. K. S. GUPTA. *Indian J. Phys.*, **25,** 313–16 (*July*, 1951).

The energy of dissociation of CN into $C(^3P)$ and $N(^4S)$ atoms has been estimated to be 6·02 V with the aid of known thermochemical and spectroscopic data. A.

539.133 : 535.343–14

1160. Pure quadrupole spectra: the substituted methanes. R. LIVINGSTON. Letter in *J. Chem. Phys.*, **19,** 1434 (*Nov.*, 1951).

The observed frequencies at 4, 20 and 77°K, and the computed nuclear quadrupole couplings at 20°K are given for Cl^{35}. Regularities are discussed. L. PINCHERLE

ATOMIC STRUCTURE . NUCLEUS ISOTOPES 539.15

539.152.1

1161. The mass difference Ni^{59}–Co^{59}. J. J. G. MCCUE AND W. M. PRESTON. Letter in *Phys. Rev.*, **84,** 384 (*Oct.* 15, 1951).

The threshold for $Co^{59}(p, n)Ni^{59}$ was found to be 7 ± 2 keV above that for $Li^7(p, n)Be^7$. It is therefore $1\,889 \pm 3$ keV, giving the Q-value as 1 857 keV and the mass difference as $0{\cdot}001155 \pm 0{\cdot}000003$ a.m.u. F. R. HOLT

539.152.1

1162. Theoretical studies in nuclear structure. IV. Wave functions for the nuclear p-shell. A. $\langle p^n | p^{n-1} p \rangle$ fraction parentage coefficients. H. A. JAHN AND H. VAN WIERINGEN. *Proc. Roy. Soc. A,* **209,** 502–24 (*Nov.* 22, 1951).

For Pt III, see Abstr. 2920 (1951). A complete set of wave functions is constructed for the whole of the nuclear p-shell (from p^3 to p^{12}). Following Racah, the wave functions for p^n are expressed as linear combinations of totally antisymmetric wave functions for p^{n-1}, vector-coupled to the wave functions of the remaining particle. The coefficients in the linear combination are expressed as the product of an orbital coefficient, a charge-spin coefficient and a weight factor equal to the square root of the ratio of the dimensions of two irreducible representations of permutation groups. Using the Young–Yamanouchi orthogonal representation of the permutation group, the orbital and charge-spin coefficients may be calculated independently. Specialization of the new method to the atomic p-shell and an alternative direct method of calculating the total parentage coefficients are described in the appendices. A reciprocal relation for the special unitary group, simplifying the calculation of both the orbital and the charge-spin coefficients, is described in an addendum. A.

539.152.1 : 539.16 : 537.591

Nuclear physics and cosmic rays: a symposium at Heidelberg. *See Abstr.* 1091

593.152.2

1163. A note on the potential of a homogeneously charged ellipsoid of rotation. S. FLÜGGE. *Z. Phys.*, **130,** 156–63 (*No.* 2, 1951) *In German.*

This is calculated and applied as a model for an atomic nucleus with a quadrupole moment. J. HUGHES

539.152.2

1164. Contributions to the investigation of pure nuclear quadrupole spectra in crystals. H. KRÜGER. *Z. Phys.*, **130,** 371–84 (*No.* 3); *erratum,* 656 (*No.* 5, 1951) *In German.*

A calculation of energy values for nuclei with spin $\frac{3}{2}$, $\frac{5}{2}$ in an inhomogeneous electric field without rotational symmetry. The ratio of quadrupole transition frequencies allows the deviation of the field

gradient from rotational symmetry to be deduced. For monocrystals the doubly degenerate term with $m_z = \pm \frac{1}{2}$ shows a linear Zeeman effect in a magnetic field perp. to the electric field axis. J. JACOBS

539.152.2

1165. On the quadrupole resonance spectrum in crystalline antimony trichloride and the ratio of the antimony nuclear quadrupole moments. H. G. DEHMELT AND H. KRÜGER. *Z. Phys.*, **130,** 385–91 (*No.* 3, 1951) *In German.*

Polycrystalline $SbCl_3$ showed 9 absorption lines between 15 and 120×10^6 sec^{-1}, which are quadrupole resonance frequencies of the Sb and Cl nuclei. The method of quadrupole resonance [Abstr. 7147 (1951)] leads to a ratio: $Q(Sb^{123})/Q(Sb^{121}) = 1{\cdot}2751 \pm 0{\cdot}0002$; $Q(Cl^{35})/Q(Cl^{37}) = 1{\cdot}2689 \pm 0{\cdot}0002$. J. JACOBS

539.152.2

1166. Theory of the breadth of nuclear quadrupole resonance lines of Cl^{35}. Y. AYANT. *C.R. Acad. Sci.* [*Paris*] **233,** 949–51 (*Oct.* 22, 1951) *In French.*

The broadening of nuclear quadrupole resonance lines due to inter-nuclear spin-spin interaction is calculated and compared with the experimental results for Cl^{35}. R. H. DALITZ

539.152.2

1167. Nuclear resonance absorption applied to precise measurements of nuclear magnetic moments and the establishment of an absolute energy scale in β-spectroscopy. G. LINDSTRÖM. *Ark. Fys.*, **4,** 1–80 (*Paper* 1, 1951).

The following frequency ratios were determined: $\nu_D/\nu_H = 0{\cdot}15350668 \pm 0{\cdot}00000012$ for H_2O and D_2O; $\nu_{Li^7}/\nu_H = 0{\cdot}3886341 \pm 0{\cdot}0000010$ for H_2O and $LiNO_3$; $\nu_{B^{11}}/\nu_H = 0{\cdot}3208381 \pm 0{\cdot}0000008$ for H_2O and $\begin{cases} Na_2B_2O_4; \\ K_2B_2O_4 \end{cases}$ $\nu_{F^{19}}/\nu_H = 0{\cdot}9409330 \pm 0{\cdot}0000030$ for H_2O and $CFCl_3$; $\nu_{Na^{23}}/\nu_H = 0{\cdot}2645182 \pm 0{\cdot}0000007$ for H_2O and $\begin{cases} Na_2B_2O_4; \\ NaBr \end{cases}$ $\nu_{Al^{27}}/\nu_H = 0{\cdot}2605694 \pm 0{\cdot}0000010$ for H_2O and $AlCl_3$. The diamagnetic correction is discussed. A chemical dependence of up to $1{\cdot}7 \times 10^{-4}$ for the proton resonance frequencies in some fluorine compounds was found. An absolute determination was made of the *Hρ* values for the *F*-, *I*- and *L*-lines of Th(B+C+C′). It was found that the ratio of the masses of the positive and negative electrons differs from unity by less than 10^{-4}. The gyromagnetic ratio for the proton was determined as $(2{\cdot}67525 \pm 0{\cdot}00020)10^4$ sec^{-1} $gauss^{-1}$. L. PINCHERLE

539.152.2

1168. Nuclear spin of rubidium-86. E. H. BELLAMY. Letter in *Nature* [*Lond.*] **168,** 556 (*Sept.* 29, 1951).

Found to be 2 by the atomic beam magnetic resonance method. The h.f.s., separation of 3 900 ± 10 Mc/s, gives a magnetic moment of $1{\cdot}66 \pm 0{\cdot}4$ nuclear magnetons, probably negative. J. HUGHES

539.152.2 : 539.132

1169. A possible relation between the nuclear relaxation time, T_2, and molecular structure. C. S. CLAY, R. S. BRADFORD AND E. STRICK. Letter in *J. Chem. Phys.*, **19,** 1429 (*Nov.*, 1951).

T_2, the reciprocal of the half-width of the proton resonance line, is given for 8 liquid hydrocarbons and is shown to be longer for the more symmetrical molecules. D. H. WHIFFEN

539.152.2 : 548.7

1170. On the theory of spin-lattice relaxation in molecular crystals. H. BAYER. *Z. Phys.*, **130,** 227–38 (*No.* 2, 1951) *In German.*

A calculation of the influence of the molecular vibration in a lattice of dichlorethylene (CHCl.CHCl) on the relaxation time of the nuclear-quadrupole moments. A rapid decrease of relaxation time t with temperature is in agreement with the experiments of Dehmelt and Krüger [Abstr. 7147 (1951)]. J. R. MADDOX

539.152.2 : 548.7

1171. Nuclear electric quadrupole interaction in crystals with nonaxially symmetric fields. H. E. PETCH, D. W. SMELLIE AND G. M. VOLKOFF. Letter in *Phys. Rev.*, **84,** 602–4 (*Nov.* 1, 1951).

Theoretical treatment and experiment for the splitting of Li nuclear magnetic resonance lines in $LiAl(SiO_3)_2$, as a result of quadrupole interaction, are in agreement. D. H. WHIFFEN

539.154.2

1172. Principal considerations in the periodic system of the elements. I. Nuclear physics considerations. R. LEPSIUS. *Z. Phys.*, **130,** 403–8 (*No.* 3, 1951) *In German.*

The derivation of magic numbers from Pascal's triangle on numerological principles. W. J. SWIATECKI

539.154.2

1173. Principal considerations in the periodic system of the elements. III. R. LEPSIUS. Note in *Naturwissenschaften*, **38,** 472–3 (*No.* 20, 1951) *In German.*

For Pt I, see preceding abstract. For Pt II, see *Umschau*, **51,** 374 (1951). W. J. SWIATECKI

539.155.2

1174. On the concentration of heavy water in glacier ice. A. E. SANDSTRÖM. *Ark. Fys.*, **3,** 549–56 (*Paper* 35, 1951).

It has been found that water from the ice of Swedish glaciers has a density higher than that of ordinary subsoil water, the excess of 0·02–0·10% corresponding to an enrichment of not less than 1–5 times the normal concentration of D_2O. The method used was the simplified Lindestrøm–Lang–Jacobsen–Johansen flotation method [*C.R. Lab. Carlsberg*, **23,** 17 (1941)]. F. LACHMAN

RADIOACTIVITY . α-, β- AND γ-RAYS 539.16

539.16 : 539.152.1 : 537.591

Nuclear physics and cosmic rays: a symposium at Heidelberg. *See Abstr.* 1091

539.16.08

1175. Alpha-particle assay and the measurement of the thorium-uranium ratio in radioactive ores. D. H. PEIRSON. *Proc. Phys. Soc.* [*Lond.*] *B,* **64,** 876–88 (*Oct.*, 1951).

The measurement of the alpha-particle activity of a "thick" radioactive source containing the natural

radioactive series is discussed critically. Two methods of determining the Th/U ratio are considered. The energy discrimination method is simple in procedure and can take account of lack of secular equilibrium between members of a series in the radioactive sample. The beta-alpha coincidence method, making use of the difference in the disintegration constants of RaC′ and ThC′, is more complicated. Initial experimental verification of the theory has been obtained. The estimated statistical error in determining the Th/U ratio by the energy discrimination method is ± 5% in the region of $Th/U = 1$, with a 4% sample (U_3O_8 equivalent concentration) in 4 min counting. A similar accuracy is obtainable in the coincidence method with a counting period 10 times greater. A.

539.16.08

1176. A note on a simple technique for obtaining absorption coefficients of metals and alloys for complex radioactive spectra. F. E. JAUMOT, JR AND F. C. NIX. Letter in *J. Appl. Phys.*, **22,** 1294 (*Oct.*, 1951).

A powdered Co–Al alloy was dispersed in an aqueous solution of polyvinyl alcohol, which was then dried as a thin foil, which was used as an absorber. The mass of metal was found by baking and decomposing the foil. F. R. HOLT

539.16.08

1177. Simple equipment to estimate radiocarbon. O. FELDSTEIN AND E. BRODA. Letter in *Nature* [*Lond.*] **168,** 599 (*Oct.* 6, 1951).

A simple all-glass filling-line and G.M. counter operated at a pressure of 1·5 cm Hg of alcohol, 3 cm A and 1–5 cm active $C^{14}O_2$ prepared and purified *in situ* from $BaC^{14}O_3$ and $HClO_4$; the plateau (~ 250 V) and its slope (1–2%/100 V up to 5 cm CO_2) are satisfactory, and the results are reproducible within ± 1·5%. There is no loss of activity (by exchange with atmospheric CO_2) with reasonably quick handling. A. O. STANESBY

539.16.08

1178. Radiation measuring instruments for X-rays to cosmic rays. D. TAYLOR AND W. ABSON. *Proc. Instn Elect. Engrs, Pt II,* **98,** 760–70 (*Dec.*, 1951) [*Paper No.* 1148].

For abstract see Abstr. 5684 (1951).

539.16.08 : 537.542

1179. Calibration of Geiger–Müller liquid counters by the radioactivity of potassium-40. T. A. CHALMERS. Letter in *Nature* [*Lond.*] **168,** 870 (*Nov.* 17, 1951).

For radioisotope tracer studies, a G.-M. counter for liquids may be calibrated with an accuracy of ± 1% in 8 min by a nearly saturated solution of K_2CO_3. Details are given, since it is suggested the method could be a basis of international standardization. T. A. CHALMERS

539.16.08 : 537.542

1180. Determination of radioactivity by solution in a liquid scintillator. M. S. RABEN AND N. BLOEMBERGEN. *Science,* **114,** 363–4 (*Oct.* 5, 1951).

C^{14}-labelled Na caproate solution was mixed with terphenyl-in-xylene scintillator in a 4 mm thick glass cell between two multiplier photocells. C^{14} can be measured in mμC amounts. F. R. HOLT

539.162.3

1181. Note on experimental determination of the half-life of ^{8}Be. J. J. WILKINS AND F. K. GOWARD. Letter in *Proc. Phys. Soc.* [*Lond.*] *A,* **64,** 849–50 (*Sept.*, 1951).

A critical study of 280 sets of $Be^8 \rightarrow 2\alpha$ tracks in Ilford E1 nuclear emulsions indicates $\sim 5 \times 10^{-14}$ sec as the *upper limit* for the ½-life of Be^8, and does not support the definite value of $(5{\cdot}3 \pm 1{\cdot}1) \times 10^{-14}$ sec for $t_{\frac{1}{2}}$ obtained by Millar and Cameron.

A. O. STANESBY

539.163

1182. The natural radioactivity of rubidium. S. C. CURRAN, D. DIXON AND H. W. WILSON. Letter in *Phys. Rev.*, **84,** 151 (*Oct.* 1, 1951).

The RbCl source was spread on the cathode of a cylindrical proportional counter. The limiting β energy was 275 keV, and the number of β's increased rapidly with decreasing energy, no peaks being found. F. R. HOLT

539.163

1183. Some new isotopes of antimony and tin. J. W. BARNES AND A. J. FREEDMAN. Letter in *Phys. Rev.*, **84,** 365–6 (*Oct.* 15, 1951).

New activities were found in Sn and Sb produced in U^{235} fission: Sn^{127}, ½-life 1·5 hr, decays to Sb^{123}; Sb^{126}, ½-life 9 hr. Activities of ½-life ~ 30 d and 10 min were also found in fission product Sb and in Sb grown from fission product Sn respectively. A. O. STANESBY

539.163.1

1184. Half-lives of excited states of Hg^{199}, Xe^{131}, and Hg^{198}. R. L. GRAHAM AND R. E. BELL. Letter in *Phys. Rev.*, **84,** 380–1 (*Oct.* 15, 1951).

Two β-spectrometers with stilbene counters were used. Half-lives measured were: 158 keV Hg^{199}, $(2{\cdot}35 \pm 0{\cdot}20) \times 10^{-9}$ sec; 207 keV Hg^{199}, $< 2 \times 10^{-10}$ sec; 80 keV Xe^{131}, $(4{\cdot}8 \pm 2{\cdot}0) \times 10^{-10}$ sec; 364 keV Xe^{131}, $< 10^{-10}$ sec; and 411 keV Hg^{198}, $< 3 \times 10^{-11}$ sec. F. R. HOLT

539.163.1

1185. Measurement of the period of a short-lived isomeric activity formed in lead by fast neutrons. J. LASCOUX AND G. VENDRYES. *C.R. Acad. Sci.* [*Paris*] **233,** 858–60 (*Oct.* 15, 1951) *In French.*

An arrangement in which alternating periods of bombardment and counting are automatically controlled was used to confirm the existence of a $0{\cdot}82 \pm 0{\cdot}02$ sec activity (cross-section $1{\cdot}5 \times 10^{-25}$ cm^2) formed in Pb irradiated with neutrons from $Be^9(d, n)B^{10}$. W. J. SWIATECKI

539.163.2

1186. ^{86}Rubidium, a new isomer of half-life 1·06 min. A. FLAMMERSFELD. Note in *Z. Naturforsch.*, **6a,** 559–60 (*Oct.*, 1951) *In German.*

A new activity was found by irradiation of Rb with fast or thermal neutrons, and ascribed to an excited state of Rb^{86}, with a ½-life of $1{\cdot}06 \pm 0{\cdot}02$ min; the isomer probably decays by *K*-capture. A. O. STANESBY

539.163.2

1187. New isotopes of berkelium and californium. E. K. HULET, S. G. THOMPSON, A. GHIORSO AND K. STREET, JR. Letter in *Phys. Rev.*, **84,** 366–7 (*Oct.* 15, 1951).

Bk and Cf isotopes obtained by bombardment of Cm^{242} (+ 5% Cm^{243} and 2% Cm^{244}) with 35 MeV helium ions and 16 MeV deuterons were examined

using a proportional counter and a differential alpha-particle pulse analyser. An α-particle activity (energies of 6·33, 6·15 and 5·90 ± 0·05 MeV) with ½-life 4·95 ± 0·1 day was assigned to Bk^{245}; the α-branching ratio is ~ 1/1000. Cm^{245}, with α-particle energy 5·4–5·8 MeV, then has a ½-life >500 yr. Cf^{246} (α-particle energy 6·75 MeV) has a ½-life of 35·7 ± 0·5 hr. A. O. STANESBY

539.163.2

1188. A cloud-chamber determination of the relative probabilities of disintegration of ^{65}Zn by *K*-capture and by positron emission. J. K. MAJOR. *C.R. Acad. Sci.* [*Paris*] **223,** 947–9 (*Oct.* 22, 1951) *In French.*

$P_K/P_{\beta+}$ was found for Zn^{65} by counting the ratio of photoelectrons (produced by the X-rays of *K*-capture) to positrons emitted; after suitable correction, the ratio obtained is $P_K/P_{\beta+} = 25 \pm 10$. This agrees with the theoretical value from the Fermi theory, but is not sufficiently accurate to determine the degree of forbiddenness of the interaction; the value on the Konopinski–Uhlenbeck theory is considerably different. A. O. STANESBY

539.163.2

1189. Research on the β-spectrum of RaD by the coincidence method. P. FALK-VAIRANT, J. TEILLAC AND C. VICTOR. *C.R. Acad. Sci.* [*Paris*] **233,** 1025–7 (*Oct.* 29, 1951) *In French.*

Coincidences due to conversion (0·74/disintegration) and Auger (0·40/disintegration) electrons were observed in G.M. counters placed on either side of a source of RaD, with suitably placed absorbers. The max. energy of the continuous β-spectrum is < 8 keV. A. O. STANESBY

539.163.2

1190. Gamma-coincident beta-spectra of I^{131}. B. H. KETELLE, H. ZELDES, A. R. BROSI AND R. A. DANDL. Letter in *Phys. Rev.*, **84,** 585 (*Nov.* 1, 1951).

A study of the coincidences between pulses in an NaI–Tl scintillation spectrometer and electrons passing through a magnetic spectrometer, using an I^{131} source, revealed that 80 keV conversion electrons are in coincidence with a 284 keV gamma-ray and that gamma-rays of energy 720, 635 and 364 keV are in coincidence with beta-groups of 250, 335 and 606 keV respectively. A decay scheme for I^{131} is given on the basis of these results. L. R. SHEPHERD

539.163.2

1191. Au^{198} decay. A. R. BROSI, B. H. KETELLE, H. ZELDES AND E. FAIRSTEIN. Letter in *Phys. Rev.*, **84,** 586 (*Nov.* 1, 1951).

Confirms 1·09 and 0·680 MeV γ's for 0·2% and 1% of the disintegrations respectively. The 680 keV γ is coincident with a 290 ± 15 keV β-group and the *K*-conversion electron peak of the 411 keV γ. F. R. HOLT

539.163.2

1192. Additional data on the radioactive isotopes of tin and tellurium. J. M. CORK, A. E. STODDARD, C. E. BRANYAN, W. J. CHILDS, D. W. MARTIN AND J. M. LEBLANC. Letter in *Phys. Rev.*, **84,** 596–7 (*Nov.* 1, 1951).

Results are reported for Sn^{113}, Sn^{117}, Sn^{123} and Te^{121}, Te^{123}, Te^{125}, Te^{127}, Te^{129}; decay schemes are suggested for Sn^{113} and Sn^{117}. A. O. STANESBY

539.163.2

1193. The decay of Fe^{52}. G. FRIEDLANDER AND J. M. MILLER. Letter in *Phys. Rev.*, **84,** 588 (*Nov.* 1 1951).

At least 95% decays to 21 minute Mn^{52}, and the electron-capture/positron ratio is 1·6 ± 0·4. The maximum positron energy is 640 ± 40 keV, and no γ's above 0·5 MeV were detected. F. R. HOLT

539.163.2 : 539.164

1194. Complex beta-decay of ^{88}rubidium. K. GEIGER. *Ann. Phys.* [*Lpz.*] **9,** 293–306 (*No.* 6–7, 1951) *In German.*

Absorption and coincidence measurements on the β- and γ-radiation of Rb^{88} gave 3 partial β-spectra with end-points at $\beta_1 = 5{\cdot}20 \pm 0{\cdot}10$ MeV, $\beta_2 = 3{\cdot}6 \pm 0{\cdot}3$ MeV and $\beta_3 = 1{\cdot}8 \pm 0{\cdot}2$ MeV, with relative intensities 4 : 1 : 1. Two γ-rays of 3·0 and 1·7 MeV (relative intensities 1 : 10) were obtained. A disintegration scheme is suggested [see also Abstr. 2974 (1951)]. A. O. STANESBY

539.164

1195. Note on the departure factor in α-decay. S. G. NORDSTRÖM. *Ark. Fys.*, **3,** 547–8 (*Paper* 34, 1951).

The decay prohibition of nuclides containing an odd neutron or proton (or both) is attributed to the nucleus, after decay, containing proton and neutron pairs in their lowest energy states and also the odd particle in its previous quantum state, i.e. excited. The energy available for α-decay may be insufficient unless α-emission is simultaneous with de-excitation of this nucleon. This may delay the α-decay. F. R. HOLT

539.164

1196. New experiments on the magnetic α spectrum of thorium C and long range [α's] from thorium C′. A. RYTZ. *C.R. Acad. Sci.* [*Paris*] **233,** 790–2 (*Oct.* 8, 1951) *In French.*

A group of 6 α's from ThC was confirmed and a new long-range α, not quite in agreement with the prediction of Latyshev [Abstr. 2971 (1947)] was established using a magnetic spectrograph. W. J. SWIATECKI

539.164

1197. Study of the alpha spectrum of radium. G. BASTIN-SCOFFIER. *C.R. Acad. Sci.* [*Paris*] **233,** 945–7 (*Oct.* 22, 1951) *In French.*

Alpha-rays from a deposit on a gold disk were analysed with a large spectrograph. An α_2 group of intensity about 3% of α_1 was confirmed, and α_1 was found to be 6·5% of the total. F. R. HOLT

539.164 : 539.166

1198. The α–γ angular correlation in the decay of radiothorium. J. K. BELING, B. T. FELD AND I. HALPERN. Letter in *Phys. Rev.*, **84,** 155 (*Oct.* 1, 1951).

Scintillation counters and freshly separated RaTh were used. A very pronounced correlation was found. Significant differences remain between the results and the most likely spin sequence $0 \xrightarrow{\alpha} 2 \xrightarrow{\gamma} 0$. F. R. HOLT

539.165 : 537.13

1199. Existence and nature of the "positive particles" near a source of radium E. F. C. CHAMPION AND A. A. AHMED. Letter in *Nature* [*Lond.*] **168,** 780 (*Nov.* 3, 1951).

Measurements were made on the tracks in a cloud

chamber of three such particles. It is suggested that the observations are consistent with the particles having $e = e_0/2$, $m = m_0/2$ or zero, where m_0 and e_0 are the electronic mass and charge. J. HUGHES

539.165.2

1200. The pseudoscalar variant theory of β-disintegration. I. M. SHMUSHKEVICH. Letter in *Zh. Eksper. Teor. Fiz.*, **21**, 661–3 (*No.* 5, 1951) *In Russian.*

Gives the energy spectrum in the pseudoscalar case. This differs significantly from the usual spectrum determined by statistical weights, and a critical test could be made by observing the β-spectrum from neutron decay. E. P. GEORGE

539.165.2

1201. On the matrix elements of the beta decay. M. TAKETANI, S. NAKAMURA, K. ONO AND M. UMEZAWA. *Progr. Theor. Phys.*, **6**, 286–94 (*May–June*, 1951).

ft values of the β-decay for forbidden transitions are classified according to the experimental spectra. They are found to fall into distinct groups, if the correct formula for the forbidden probabilities of Fermi theory worked out by Nakamura, Shima and Kobayasi are adopted. The possible selection rules, and the conditions for the uniqueness of the matrix elements adopted, are also discussed. From the results, interaction types of the Fermi theory could be limited to some extent. A.

539.165.2

1202. Nuclear shell model and the β-decay schemes. I. M. UMEZAWA, S. NAKAMURA, Y. YAMAGUCHI AND M. TAKETANI. *Progr. Theor. Phys.*, **6**, 408–25 (*May–June*, 1951).

The spin-orbit coupling shell model is introduced for nuclei with even mass number besides that for odd mass nuclei. The overall agreement between Mayer's shell model and the Fermi theory of β-decay is shown to be very satisfactory. It is also shown that the type of nuclei predicted by the spin-orbit shell theory is useful for the study of analysis of β-decay schemes and the nuclear spectroscopy. A.

539.165.2

1203. Nuclear matrix elements of β-decay. H. BRYSK. Letter in *Phys. Rev.*, **84**, 362–3 (*Oct.* 15, 1951).

An evaluation of these using a single-particle model in the Dirac representation with the term assignment of the shell model shows the importance of the relativistic treatment in spectrum shape predictions and the classification of *ft* values. W. J. SWIATECKI

539.165.2

1204. The interaction in the theory of beta decay. D. L. PURSEY. *Phil. Mag.*, **42**, 1193–1208 (*Nov.*, 1951).

The cross terms occurring in the expression for the theoretical *n*th forbidden beta-spectrum are given for an arbitrary mixture of interactions. Relations are derived between the 6 first forbidden vector nuclear matrix elements. Comparison with experiment is made for first forbidden transitions with allowed-shape beta-spectra. The results are discussed in relation to other recent work in the theory of beta-decay. It is concluded that the interaction is most probably tensor with little or no admixture of other interactions. A.

539.166

1205. Spectrometric study of the γ-radiation of As^{76}. P. HUBERT. Letter in *J. Phys. Radium*, **12**, 823–4 (*Oct.*, 1951) *In French.*

Compton and photoelectrons produced by the γ-rays of As^{76} in Cu, Pb, Au and U were examined in a magnetic lens β-spectrometer; γ-rays found were: γ_1, $0{\cdot}555 \pm 0{\cdot}002$ MeV (relative intensity 1); γ_2, $0{\cdot}648 \pm 0{\cdot}002$ (0·095); γ_3, $1{\cdot}210 \pm 0{\cdot}005$ (0·25); γ_4, $1{\cdot}410 \pm 0{\cdot}006$ (0·016); γ_5, $2{\cdot}06 \pm 0{\cdot}01$ (0·055). A disintegration scheme is suggested [see also Abstr. 1186 (1950)]. A. O. STANESBY

539.166 : 778.33

1206. Some aspects of cobalt radiography. D. T. O'CONNOR AND J. J. HIRSCHFIELD. *Non-destr. Test.*, **10**, 33–9 (*No.* 1, 1951).

Scatter, and unsharpness due to scatter, are investigated. Co^{60} has a greater specific activity than Ra and is therefore a better source for radiography. The unsharpness due to Ra sources is greater than that due to Co^{60} sources. Unsharpness due to scattering is proportional to the thickness of the absorber. Sensitivity is directly proportional to unsharpness. A combined sensitivity technique chart has been developed. W. SUMMER

539.166.835

1207. Impulse at the annihilation of slow positrons in various solid substances. H. MAIER-LEIBNITZ. *Z. Naturforsch.*, **6a**, 663–7 (*Nov.*, 1951) *In German.*

180° coincidences between the γ's from the annihilation of positrons from Na^{22}, which was placed in a cyclotron deuteron beam, were found to depend on the substance used. This variation is caused by the angle between the two γ's depending on the outer electrons, in the lattice. Al, Cu, Ag, Sn, Ta, W, Au, Pb and Bi were investigated, and suggest that the deeper shells also have an effect. F. R. HOLT

539.166.835

1208. Cross-over transition in Te^{123}. B. HAMERMESH AND V. HUMMEL. Letter in *Phys. Rev.*, **84**, 381–2 (*Oct.* 15, 1951).

The 248 keV/159 keV γ-ratio was measured as less than 0·5%. 7% was expected from theory. F. R. HOLT

539.167.3

1209. A carrier-free separation of UZ from UX. F. BARENDREGT AND S. TOM. *Physica*, **17**, 817–20 (*Sept.*, 1951).

The Pa fraction and the Th fraction of UX were separated using an IMAC C 240 ion-exchange column. Carrier-free UZ sources could be prepared contaminated with only 0·8% of the radiations of UX and UX_2. The half-life of UX_2 was estimated to be $1{\cdot}175 \pm 0{\cdot}003$ min. A.

NUCLEAR REACTIONS 539.17

539.172 : 537.591.8

Nuclear reactions due to cosmic rays. *See Abstr.* 1091, 1105–8

539.172.13

1210. Scattering of 146 MeV protons by deuterons. J. M. CASSELS, G. H. STAFFORD AND T. G. PICKAVANCE. Letter in *Nature* [*Lond.*] **168**, 556–7 (*Sept.* 29, 1951).

Protons and deuterons, emerging from heavy water after elastic p–d collisions, were detected in coincidence by counters set at the appropriate angle. Backgrounds were subtracted by making measurements with ordinary water. Inelastic and p–p collisions were ruled out by the geometry. Results are presented graphically for c. of m. angles between 50° and 160°, and show a forward and a backward rise in the cross-section, with a broad valley of about 0·4 mb/steradian.

T. G. PICKAVANCE

539.172.13

1211. Yields of iron isotopes in high energy nuclear reactions. J. M. MILLER AND G. FRIEDLANDER. Letter in *Phys. Rev.*, **84**, 589 (*Nov.* 1, 1951).

370 MeV protons were used. The formation cross-section ratios found were, for Fe^{55}/Fe^{52}, 136 ± 20 for a thin Co target, 168 ± 25 for thin Cu, and 206 ± 30 for thick Cu. Fe^{59}/Fe^{52}, from thick Cu, was 45 ± 15.

F. R. HOLT

539.172.13

1212. Evidence regarding instability of H^4. G. BREIT AND J. S. MCINTOSH. Letter in *Phys. Rev.*, **83**, 1245 (*Sept.* 15, 1951).

See Abstr. 9701 (1951). The allowable range of mass value determined by these experiments, and corresponding half-period values, are tabulated and discussed. The existence of a stable H^4 is improbable.

539.172.13

1213. Effect of target thickness in the search for H^4. J. S. MCINTOSH. Letter in *Phys. Rev.*, **83**, 1246 (*Sept.* 15, 1951).

See preceding abstract. Describes the basis of comparison of the $H^3(d, p)H^4$ search of Abstr. 9701 (1951) and the $Li^7(d, p)Li^8$ experiment performed at the same time.

539.172.13

1214. Studies of nuclear collisions involving 8 MeV deuterons by the photographic method. I. The experimental method. H. B. BURROWS, C. F. POWELL AND J. ROTBLAT. *Proc. Roy. Soc. A*, **209**, 461–77 (*Nov.* 22, 1951).

An improved apparatus for the study of disintegrations produced by high-energy particles accelerated in a cyclotron has been constructed. The instrument employs the photographic method of detecting charged particles, and allows the numbers and energy of the scattered and disintegration products to be determined—at any angle with respect to the primary beam, in the interval from 15 to 165°—as a result of a single exposure. By means of a slit system, the spread in energy of the deuteron beam from the Liverpool cyclotron has been reduced to 60 keV, and the angular divergence of the beam to ± ½°. "Targets" composed of gases or thin foils have been used. The Q-values of the resulting nuclear reactions which lead to the emission of protons and α-particles can, in the refined conditions provided by the instrument, be determined to within ± 0·03 MeV; separate proton groups with a difference of energy of 0·08 MeV can be resolved.

A.

539.172.13

1215. Studies of nuclear collisions involving 8 MeV deuterons by the photographic method. II. The energy of the excited states of ^{17}O. H. B. BURROWS, C. F. POWELL AND J. ROTBLAT. *Proc. Roy. Soc. A*, **209**, 478–88 (*Nov.* 22, 1951).

The apparatus described in Pt I has been employed to determine the energy of the excited states of the nucleus O^{17} by observations on the protons from the reaction $O^{16}(d, p)O^{17}$, and on the α-particles from the reaction $F^{19}(d, \alpha)O^{17}$. The protons from the first reaction were observed at 5 angles of emission with respect to the primary beam, and the α-particles from the second at 4 angles. Thirteen excited states of O^{17} were observed, evidence for 10 of which was given by both reactions. The values for the energy in the different excited states, derived from both reactions and at different angles of observation, are in good agreement. The Q-values of the reactions $O^{16}(d, p)O^{17}$ and $F^{19}(d, \alpha)O^{17}$, in which the O^{17} nucleus is formed in its ground state, are 1·928 and 10·042 MeV, respectively. The Q-value for the reaction $O^{16}(d, \alpha)N^{14}$ was found to be 3·09 MeV, and the existence of two excited states of N^{14} was established. Ten excited states of F^{20} were observed in a study of the proton groups from the reaction $F^{19}(d, p)F^{20}$.

A.

539.172.13

1216. Studies of nuclear collisions involving 8 MeV deuterons by the photographic method. III. Angular distribution of the charged particles produced by the bombardment of hydrogen and deuterium. H. B. BURROWS, W. M. GIBSON AND J. ROTBLAT. *Proc. Roy. Soc. A*, **209**, 489–501 (*Nov.* 22, 1951).

Apparatus described in Pt I has been used to study the angular distribution of the charged particles from nuclear processes initiated by 8 MeV deuterons. The experimental technique and the method of obtaining relative values of the yield at different angles in the centre-of-mass system are described. Results of measurements on the elastic collision of deuterons with protons are given, together with an account of the method for obtaining absolute values of cross-sections from the relative values, using the known cross-section for this process measured by other experimenters. Angular distributions obtained for deuterons elastically scattered by deuterons, and for protons from the reaction $H^2(d, p)H^3$, are produced, and their interpretation discussed.

A.

539.172.3

1217. High-energy nuclear photoeffect in carbon. D. WALKER. Letter in *Phys. Rev.*, **84**, 149–50 (*Oct.* 1, 1951).

The results of measurements on high-energy photoprotons emitted in the bombardment of C by 195 MeV synchrotron bremsstrahlung, reported in an earlier paper [Abstr. 4722 (1951)] are re-examined in the light of new data on the γ-ray intensity and after making allowance for the loss of tracks of protons with residual energies >50 MeV (too energetic to be recorded in the Ilford C2 plates used in the measurements). The total cross-sections for the production of protons with energies >70 MeV and >90 MeV are now given

as $2{\cdot}3 \pm 1{\cdot}6\times10^{-28}$ cm² and $9 \pm 6\times10^{-29}$ cm² respectively. L. R. SHEPHERD

539.172.4

1218. The scattering of neutrons by deuterons at high energies. B. H. BRANSDEN. *Proc. Roy. Soc. A*, **209**, 380–96 (*Nov.* 7, 1951).

Born's approximation has been used to calculate total elastic and inelastic cross-sections and angular distributions for the scattering of neutrons by deuterons at incident energies of 100, 200 and 300 MeV. The nuclear potential has been taken to be a mixture of central and non-central interactions of the type $\mathcal{V}_{12} = I_{12}(1 - \frac{1}{2}g + \frac{1}{2}g\sigma_1\sigma_2 + \gamma S_{12})V(r)$, where $S_{12} = r^{-2}3\sigma_1 . \mathbf{r}\sigma_2 . \mathbf{r} - \sigma_1 . \sigma_2$. Four types of isotopic factor I_{12}, giving exchange properties of the neutral, charge exchange, symmetrical and Serber theories, have been investigated. The effect on the scattering of including the D wave of the ground state of the deuteron has been estimated. A.

539.172.4

1219. The application of cold welding to sealing samples for neutron irradiation in a reactor. P. B. AITKEN. Letter in *Rev. Sci. Instrum.*, **22**, 799–800 (*Oct.*, 1951).

ATOM AND MOLECULE BEAMS . MESONS NEUTRONS 539.18

539.18

1220. The properties of neutral V-particles. R. ARMENTEROS, K. H. BARKER, C. C. BUTLER AND A. CACHON. *Phil. Mag.*, **42**, 1113–35 (*Oct.*, 1951).

In a cloud-chamber investigation at 2 867 m altitude 70 V-tracks due to the decay of neutral V-particles have been observed. An analysis has been made on the basis of the two-body decay processes: $V_1^0 \rightarrow p^+ + \pi^-$ and $V_2^0 \rightarrow \pi^+ + \pi^-$ and it is concluded that the present limited data are consistent with these two processes. The ratio of the numbers of the two types of V-particles is found to be $N_{V^0_1}/N_{V^0_2} = 1{\cdot}6 \pm 0{\cdot}5$ and accurate mass estimates have been obtained for 12 examples of the first type of decay and for eight examples of the second type. The results are consistent with the unique mass values $(2\,203 \pm 12)m_e$ and $(796 \pm 27)m_e$ respectively. The possibility that there are neutral secondary particles among the decay products cannot be excluded. However, some evidence is presented that seems to exclude an explanation of the observations in terms of two modes of decay of a heavy particle each giving a nucleon and two mesons. Finally, it is concluded that there are probably two different types of neutral V-particles. A.

539.18 : 539.166

1221. Formation of neutral mesons by γ-quanta. A. BALDIN AND V. MIKHAĬLOV. Letter in *Zh. Eksper. Teor. Fiz.*, **21**, 562–3 (*No.* 4, 1951) *In Russian.*

The theoretical angular distributions for π^0-meson production are given for target protons and neutrons separately. The former is almost isotropic, the latter shows a pronounced forward peak.

E. P. GEORGE

539.181

1222. Optical picture formation with neutral atoms. H. FRIEDBERG. *Z. Phys.*, **130**, 493–512 (*No.* 4, 1951).

An inhomogeneous magnetic field is used to induce a dipole moment in the atoms. The field strength must be proportional to the distance from the optical axis, an example being $H_x = x^2 - y^2$, $H_y = -2xy$, $H_z = 0$. The aberrations are discussed. An experimental arrangement is described, in which the field is produced by means of the current in 6 circular wires, arranged with their centres on the circumference of a circle, the current being in opposite directions in adjacent wires. The results were in general agreement with the theory, but the background was much higher than expected and there is some evidence of other aberrations, possibly connected with the hyperfine structure of the K atoms used. See also Abstr. 7287 (1951). A. H. W. BECK

539.185

1223. On the spectral sensitivity of a neutron counter with shielding. G. PFOTZER. *Z. Naturforsch.*, **6a**, 679–88 (*Nov.*, 1951) *In German.*

Theoretical. A calculation is given, assuming a cylindrical BF_3 counter surrounded by a cylindrical paraffin block, for the probability that neutrons within a given energy range will be slowed down to thermal energy by the paraffin shielding; and hence the spectral sensitivity is determined. J. THEWLIS

539.185 : 539.162

1224. The decay of neutrons into neutral hydrogen atoms. S. G. COHEN. Letter in *Phys. Rev.*, **84**, 591 (*Nov.* 1, 1951).

From Sherk's formula [Abstr. 2669 (1949)] the κ-creation/β-decay ratio for the neutron is 6×10^{-6}. After κ-creation the H-atom should recoil with 283 eV. F. R. HOLT

539.185 : 545.8

Chemical analysis of neutron spectroscopy. *See Abstr.* 1301

539.185 : 548.74

1225. On the scattering of slow neutrons by a crystal lattice of ordered alloys of arbitrary composition. A. A. SMIRNOV AND B. V. PADUCHEV. *Zh. Eksper. Teor. Fiz.* **21**, 541–6 (*No.* 4, 1951) *In Russian.*

The influence of composition and degree of long-range order is investigated and extended to the case of non-stoichiometric composition. Types of cubic lattices discussed are: body centred, face centred, and of NaCl type. The scattering leads to a dependence of the background intensity as in the case of, e.g., residual electrical resistance in ordered alloys.

J. JACOBS

539.185.7 : 615.849 : 778.34

1226.* Use of nuclear research emulsions for fast-neutron dosimetry. H. A. B. SIMONS. Letter in *Nature* [*Lond.*], **168**, 835–6 (*Nov.* 10, 1951).

The measured energy deposition of elastically scattered protons in the emulsion is converted to energy deposition in tissue (i.e. neutron dosage) by using the ratio of the atomic density of H in the two materials. D. V. MABBS

STRUCTURE OF SOLIDS 539.2

539.215.2

1227. On the cube texture in face-centred cubic metals. E. SCHMID AND H. THOMAS. *Z. Phys.*, **130**, 293–303 (*No.* 3, 1951) *In German.*

A discussion of rolling and recrystallization textures in copper and 50% nickel iron. The results of experimental work on the conditions necessary for the occurrence of the technically important cube texture are described. With large amounts of cold-reduction a third principal texture [110] (001) is observed. Both this texture and the recrystallization texture [100] (001) are dependent on the degree of cold-reduction. The necessary conditions for the formation of the cube texture are found to be (*a*) the cold-reduced strip must contain a considerable amount of the texture [111] (112), and (*b*) the material must exhibit marked elastic anisotropy. A. E. DE BARR

539.215.7 : 533.5

1228. Melting and sintering of metals in vacuo. E. D. MALCOLM. *J. Sci. Instrum., Suppl. No.* 1 [*Vacuum Physics*] 63–6 (1951).

The advantages and applications of melting and sintering in a vacuum are surveyed. The various problems peculiar to the use of a furnace in a vacuum enclosure, and the design of such a furnace suitable for melting 50 to 100 lb of steel are discussed. A.

539.234

1229. Contamination of evaporated films by the supporting material of the source. O. S. HEAVENS. Letter in *Nature* [*Lond.*] **168,** 664 (*Oct.* 13, 1951).

This is discussed for the case of tantalum as the supporting material and figures for the degrees of contamination found given. H. P. MYERS

539.234

1230. Observations relative to the metallization of surfaces by evaporation *in vacuo*. L. DUNOYER. *C.R. Acad. Sci.* [*Paris*] **233,** 919–21 (*Oct.* 22, 1951) *In French.*

States that electron bombardment is more suitable than ionic bombardment for the cleaning of glass surfaces if stable highly reflecting Al films are to be prepared by evaporation. H. P. MYERS

539.234 : 533.5

1231. Recent advances in vacuum coating plant and techniques. L. HOLLAND. *J. Sci. Instrum., Suppl. No.* 1 [*Vacuum Physics*] 59–62 (1951).

Advances in the design of vacuum evaporation plant are shown by reference to a typical plant used for anti-reflection filming of lenses. Methods of removing surface contaminants by ionic and electron bombardment cleaning are reviewed. Recent industrial applications of vacuum coating, including the metallizing of plastic foils and cathode-ray fluorescent screens, are described. A.

539.27

1232. Inorganic replication in electron microscopy. C. J. CALBICK. *Bell Syst. Tech. J.*, **30,** 798–824 (*Oct.* (I) 1951).

Contrast and resolution are determined by the geometrical relationships between the directions of incidence of the condensing atom beam and the local surface normal, during film formation, and the direction of incidence of the electron beam in the microscope. Replica films may be formed of any material suitable for vacuum evaporation. Metal atoms in general tend to stick where they strike. Oxides such as silica and silicon monoxide, and also the semi-metal Ge, form amorphous films. A portion of the incident material, about 50% in the case of silica, migrates large distances, 5 000 Å or more, before finally condensing. The existence of a minimum perceptible mass thickness difference results in an optimum replica mass thickness. The resolution of the film is inversely proportional to its density. The importance of stereoscopic methods is discussed. A.

539.27

1233. Structure of amorphous aluminium oxide films. H. G. F. WILSDORF. Letter in *Nature* [*Lond.*] **168,** 600–1 (*Oct.* 6, 1951).

It is stated that particles consisting of two Al_2O_3 molecules could give rise to the observed electron diffraction pattern of Al_2O_3. H. P. MYERS

539.27

1234. A method for making ultra-thin tissue sections for electron microscopy at high resolution. F. SJÖSTRAND. *Nature* [*Lond.*] **168,** 646–7 (*Oct.* 13, 1951)

A technique is described for preparing sections a few hundred angstroms thick for electron microscopy. The sections are embedded in a collodion film on the surface of an accurately finished glass plate mounted in a specially constructed microtome, and cut without deformation by a specially sharpened razor blade. The part that is cut away is discarded, the remaining part being used for examination in the electron microscope. M. R. HOPKINS

539.27

1235. Negative charging of glass fibers under electron bombardment. J. H. L. WATSON. Letter in *J. Appl. Phys.*, **22,** 1387–8 (*Nov.*, 1951).

Kern and Kern recently suggested that the increased image dimensions of shadow cast over non-shadow cast objects in electron microscopy could be explained by negative charging of the objects [Abstr. 7532 (1950)]. The present note proves experimentally that glass fibres do, in fact, store a negative charge and behave in accordance with the hypothesis.

A. H. W. BECK

539.27 : 548.74

1236. Structure of oxide replica for electron microscopy. S. YAMAGUCHI. Letter in *J. Appl. Phys.*, **22,** 1295–6 (*Oct.*, 1951).

The "structureless" oxide film found on the etched surface of an Fe single crystal is found to be composed of oriented crystals of 50–100 Å in size. J. THEWLIS

539.27 : 548.74

1237. Techniques and applications of electron diffraction in industrial research. A. STAHL. *Z. angew. Phys.*, **3,** 349–60 (*No.* 9, 1951) *In German.*

This, the first of two papers, gives a survey of the theory of electron diffraction and of the apparatus and methods used in its application. Reference is made to 284 publications of which 150 are listed in detail in this instalment. J. THEWLIS

ELASTICITY . STRENGTH . RHEOLOGY
539.3/.8

539.31

1238. The force on an elastic singularity. J. D. ESHELBY. *Philos. Trans. A*, **244**, 87–112 (*No.* 877, 1951).

A general theory of the forces on singularities in a Hookean elastic continuum is developed. The singularity is taken to be any state of internal stress satisfying the equilibrium equations but not the compatibility conditions. The force on a singularity can be given as an integral over a surface enclosing it. The integral contains the elastic field quantities which would surround the singularity in an infinite medium, multiplied by the difference between these quantities and those actually present. The expression for the force is thus of essentially the same form whether the force is due to applied surface tractions, other singularities or the presence of the free surface of the body ("image force"). A region of inhomogeneity in the elastic constants modifies the stress field; if it is mobile one can define and calculate the force on it. The total force on the singularities and inhomogeneities inside a surface can be expressed in terms of the integral of a "Maxwell tensor of elasticity" taken over the surface. Possible extensions to the dynamical case are discussed. A.

539.312

1239. Experimental studies on the internal friction in solids. T. NISHIHARA AND H. MIKI. *Tech. Rep. Engng Res. Inst. Kyoto Univ.*, **1**, 1–18 (*No.* 1, 1951).

A dashpot, spring and friction element model is proposed and investigated in some detail. The log decrement is calculated, and its dependence on frequency is compared with the experimental results obtained on cold drawn brass and 0·8% carbon steel. Both drawn and quenched samples of the latter were tested before and after annealing at various temperatures. These results are also compared with Zener's thermo-elastic theory. Some details of the experiments are given; the log dec. was determined from a photographic record of the amplitude of transverse vibrations of freely suspended specimens.

J. E. CAFFYN

539.32

1240. Frequency dependence of elastic constants and losses in nickel. R. M. BOZORTH, W. P. MASON AND H. J. MCSKIMIN. *Bell Syst. Tech. J.*, **30**, 970–89 (*Oct.* (I) 1951).

The elastic constants of Ni crystals, and their variation with magnetic field (ΔE effect), have been measured by a 10-megacycle ultrasonic pulsing method. The constants of three crystals agree well with one another when the crystals are magnetically saturated, but vary with domain distribution when demagnetized. The maximum ΔE effect observed is much less (3%) than has been observed at lower frequencies (20%). By measuring the ΔE effect and the decrement of polycrystalline rods at low frequencies, it is shown that the small effect observed at 10 megacycles is due to a relaxation in the domain wall motion due to micro-eddy-current damping. From the initial slope of the decrement-frequency curve, and also from the frequency of maximum decrement, the size of the average domain is found to be about 0·04 mm. A.

539.32

1241. Compressibilities of cubic crystalline powders: a new method of measurement. S. BHAGAVANTAM AND T. SESHAGIRI RAO. Letter in *Nature* [*Lond.*] **168**, 744 (*Oct.* 27, 1951).

Two relations between the elastic constants of a closely packed polycrystalline aggregate of cubic crystals and the latter's elastic constants are quoted. These enable the bulk modulus of the aggregate to be found and the Cauchy relations for the crystal to be tested. J. E. CAFFYN

539.32 : 539.67

1242. A torsion pendulum with a double elastic suspension for measuring the internal friction and elastic modulus of metals over a range extending from the lowest temperatures to 1300°C; a pendulum hysteresis meter. C. BOULANGER. *C.R. Acad. Sci.* [*Paris*] **233**, 732–3 (*Oct.* 1, 1951) *In French.*

539.32 : 548.7 : 539.11

Elastic constants of alkali halide crystals. *See Abstr.* 1142

539.37 : 548.7

1243. The theory of displacements in one-dimensional atomic lattices. II. Arbitrary ordered and accelerated displacements. A. SEEGER AND A. KOCHENDÖRFER. *Z. Phys.*, **130**, 321–36 (*No.* 3, 1951) *In German.*

Continuation of earlier work [see Abstr. 7541 (1950)] in which solutions corresponding to accelerated motion of one part of the crystal with respect to another part are obtained. The effect of time-dependent forces (corresponding to vibrations of the lattice) and the extension of this to the two-dimensional problem are discussed briefly. J. R. MADDOX

539.373

1244. Micro-slip in metal crystals. A. F. BROWN AND R. W. K. HONEYCOMBE. *Phil. Mag.*, **42**, 1146–9 (*Oct.*, 1951).

Al crystals, the surfaces of which have been prepared for examination solely by electropolishing, show extremely fine slip bands (displacements of 150 Å or less) after small plastic deformations of about 0·5–2%. The more familiar coarse bands involving displacements of the order of 5 000 Å appear subsequently. However, if the metal surface is mechanically polished prior to electrolytic polishing, the coarse bands occur in the earliest stages of deformation. Two possibilities are considered: firstly that the micro-slip is a phenomenon restricted to the vicinity of the surface and is highly dependent on the nature of it. Secondly it is suggested that the fine slip is typical of initial slip processes within the metal, but becomes almost entirely suppressed as the deformation proceeds. A.

539.373 : 548.0

Artificial slip formation. *See Abstr.* 1304–5

539.373 : 548.0

1245. Distribution of slip in metal crystals. F. C. FRANK. Letter in *J. Appl. Phys.*, **22**, 1387 (*Nov.*, 1951).

A recent paper by Kurnosov, Tronina and Yakutovich [Abstr. 2158 (1949)] claiming the result that the

deformation of Zn crystals is largely homogeneous and not concentrated in slip packets, is severely criticized, and the data presented therein shown to support the opposite result. A. D. LE CLAIRE

539.374

1246. Approximation methods in the theory of viscoelastic behaviour. I. F. SCHWARZL. *Physica*, **17**, 830–40 (*Sept.*, 1951).

Using Alfrey's approximation method a complete system of approximate equations is obtained. By differentiation of the creep curve, resp. the relaxation curve the retardation spectrum resp. the relaxation spectrum can be found without using the elasticity modulus. The creep curve and the relaxation curve are reciprocal and yield unity on multiplication. The relaxation curve is a continuation of the real part of the complex elasticity modulus so that these two curves can be considered as two branches of the "generalized relaxation curve." In the same way the creep curve without flow yields together with the real part of the compliance, the "generalized creep curve." The spectra can be obtained from the generalized curves by differentiation, a formalism which may be transferred into the logarithmic time scale (chapter 6). A.

539.374

1247. The deformation of visco-elastic solids. J. MANDEL. *C.R. Acad. Sci.* [*Paris*] **233**, 1003–5 (*Oct.* 29, 1951).

539.374

1248. The synthesis of elastic dislocation fields. F. R. N. NABARRO. *Phil. Mag.*, **42**, 1224–31 (*Nov.*, 1951).

The static field of an infinitesimal loop of dislocation lying in its glide plane is calculated. The field of any plane loop lying in its glide plane may be obtained by integration of the result. The field produced by the sudden creation of an infinitesimal loop is calculated as a function of time. The field of an arbitrarily moving plane loop may be obtained by integration. The method is illustrated by simple examples. A.

539.374

1249. A theoretical derivation of the plastic properties of a polycrystalline face-centred metal. J. F. W. BISHOP AND R. HILL. *Phil. Mag.*, **42**, 1298–1307 (*Nov.*, 1951).

In continuation of a previous paper [Abstr. 5831 (1951)] it is conjectured that the work done in plastically deforming a polycrystal is approximately equal to that which would be done if the grains were free to deform equally. In conjunction with the principle of maximum plastic work, this enables the yield function of an aggregate to be calculated. This is done for an isotropic aggregate of face-centred cubic crystals, following a determination of the stresses needed to produce multi-slip. The theoretical yield criterion lies between those of Tresca and von Mises, in good agreement with observation for Cu and Al. It is shown further that the work-hardening of an aggregate would be a function only of the total plastic work if the grains hardened equally: the departure from this functional relation is expressed explicitly in terms of the non-uniform hardening. A.

539.4.016 : 537.533.73

Electron transmission through thin metal sections with application to self-recovery in cold worked aluminium. *See Abstr.* 1055

539.4.016.2 : 537.312.9

1250. The electrical resistivity of cold-worked copper-iron alloys. F. E. HETHERINGTON AND J. REEKIE. Letter in *J. Appl. Phys.*, **22**, 1293–4 (*Oct.*, 1951).

The resistivity, ρ, shows a peak at 0·26% Fe, the general form of the ρ against composition curve being maintained as the alloys are cold-worked, but shifted positively parallel to the ρ-axis with a sharpening of the peak. If alloy and pure Cu are subjected to the same amount of cold-work, then the quantity $(\rho_{alloy}-\rho_{Cu})$, when plotted against cold-work, gives a measure of the effect of cold-working on the Fe present. There is a distinct change in the character of the curves as the Fe content increases, and it is concluded that if the Fe is in solution, the resistivity contribution by the Fe does not alter with cold-working, but that if the Fe is precipitated then the contribution increases. A. J. KENNEDY

539.4.016.2 : 537.312.9

1251. Change of resistivity of gold by cold-working at liquid-air temperature and its recovery by temporary heating. M. J. DRUYVESTEYN AND J. A. MANINTVELD. Letter in *Nature* [*Lond.*] **168**, 868–9 (*Nov.* 17, 1951).

Evidence for two processes of recovery occurring at different heating temperatures is given. It is suggested that these are due to conglomerates of vacant places and vacant lattice sites. J. E. CAFFYN

539.4.016.2 : 539.21 : 536.66

1252. A method for determining the energy stored during cold-working of metals. M. B. BEVER AND L. B. TICKNER. Letter in *J. Appl. Phys.*, **22**, 1297–8 (*Oct.*, 1951).

The heat of solution of cold-worked and annealed samples of gold-silver alloy in tin is measured calorimetrically. J. E. CAFFYN

539.4.016.3 : 536.531

1253. Annealing of platinum for thermometry. R. J. CORRUCCINI. *J. Res. Nat. Bur. Stand.* [*Wash.*] **47**, 94–103 (*Aug.*, 1951).

Experiments are described on the annealing of Pt wire in which the coefficient of resistance and thermal electromotive force were used as criteria of the physical state of the metal. It was found that Pt wire of the highest available purity almost completely recovers its electrical properties at a temperature as low as 300°C, although a slight further recovery occurs with increase of annealing temperature up to 1 450°C. On quenching heated wires in various gaseous media, changes in the electrical properties occur that are greater the more rapid the quenching and that are similar to the effect of strain. The electrical properties of dilute alloys of Au, Ag and Cu in Pt were measured. Contrary to prediction, the Cu and Ag alloys were thermoelectrically positive to Pt at ordinary temperatures. Thus far, no impurity other than Au has been found to lower the thermoelectric power of Pt. It is apparently not possible to represent the kinetics of annealing in terms of a temperature activated

process having a single value of activation energy. This result is interpreted in terms of the diffusion of dislocations. A.

539.42 : 539.11

1254. The yielding behavior of iron single crystals. A. N. HOLDEN. Letter in *J. Appl. Phys.*, **22**, 1290–1 (*Oct.*, 1951).

Further experiments on carbonized crystals. A yield point is never found in completely annealed specimens, but is if they are slightly strained and annealed for 1 hr at 100°C. The larger of two otherwise identical crystals always shows the more pronounced yield point and the greater yield point elongation. A yield point is shown by crystals aged after deformation by tension but not if the deformation is by rolling. A theory based on the interaction of dislocations by collision is employed in discussion of the results. A. D. LE CLAIRE

539.434

1255. Formula for creep curves of metals. R. R. HASIGUTI AND T. OWADANO. Letter in *Nature* [*Lond.*] **168**, 706 (*Oct.* 20, 1951).

The formula $s = a - (bt + c)^{-1} + kt$ is proposed where t is time and s the resolved shear strain (single crystals) or $\log_e R$ (polycrystalline specimens) where R is the ratio (length at time t)/(original length), and a, b, c, k are constants. The fit of this equation to one polycrystalline and one single crystal test with Al is demonstrated by comparison of calculated and experimental values, and it is claimed that the fit is superior to that given by Andrade's equation, $l = l_0(1 + \beta t^{1/3}) \exp(kt)$, where l_0, β and k are constants. No values of the constants used in the calculations are given. A. J. KENNEDY

539.533

1256. A theory of Rockwell ball hardness. M. A. DU TOIT MEYER. *Appl. Sci. Res.*, **A3**, 11–26 (*No.* 1, 1951).

A theoretical analysis of the Rockwell method of ball hardness measurements is made. A general expression for Rockwell ball hardness numbers in terms of the Meyer constants n and b is given. It is shown that the theoretical results are in agreement with experimental results. The conversion of Meyer and Brinell hardness numbers to Rockwell hardness numbers is discussed. A.

539.61

1257. Friction and wear in the physics of surfaces. A. MARCELIN. *J. Phys. Radium*, **12**, 1A–16A (*Oct.*, 1951) *In French.*

The friction between two solid surfaces is initially due to the roughness of the surfaces. Wear results in the removal of asperities, causing a friction dependent on the molecular forces between the two surfaces. Studies of the friction and wear with and without lubricating films are described. It is found that transfer of material between the surfaces always takes place with dry friction but does not occur in the presence of a lubricant. It is estimated that the order of magnitude of the range of the surface forces is 10^{-7} cm. H. P. MYERS

539.62 : 545.8

1258. A study of metal transfer during sliding, using radioactivation analysis. E. RABINOWICZ. Letter in *Proc. Phys. Soc.* [*Lond.*] *A*, **64**, 939–40 (*Oct.*, 1951).

Fragments transferred between sliding surfaces of copper and steel were detected autoradiographically after irradiation of the specimens with neutrons, making use in one case of the very different neutron capture cross-sections of the respective metals, and in the other of the different $\frac{1}{2}$-lives of the radioactive products. A. O. STANESBY

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM . CHEMICAL REACTIONS 541.11/.12

541.123.2

1259. The free energy diagram of the vanadium-oxygen system. N. P. ALLEN, O. KUBASCHEWSKI AND O. VON GOLDBECK. *J. Electrochem. Soc.*, **98**, 417–24 (*Nov.*, 1951).

A review of earlier work permits the derivation of the free energy diagram from composition V_2O_5 down to beyond composition VO. Results of some H reduction experiments are in accordance with the energy relations derived. The slope of the energy curve at low concentrations of O has been determined by establishing equilibria between V–O solutions and molten Ba, Mg or Ca. The O contents in V thus obtained were determined by the vacuum fusion method. A.

541.123.5

1260. Exchange of carbon atoms between carbonate and cobalti-tricarbonate ions studied by means of C^{14}. D. MARX. *C.R. Acad. Sci.* [*Paris*] **233**, 865–7 (*Oct.* 15, 1951) *In French.*

Brief experimental details are given for treatment of cobalt cobalti-tricarbonate with radioactive radium bicarbonate in aqueous solution, precipitation of the complex formed with glycerine, filtration and precipitation of carbonate ions in the filtrate as barium carbonate. Comparison of the radioactivities of the two precipitates shows an exchange of <1% after 15 hr treatment. This stability, as contrasted with the 50% exchange when cobalti-tetrammine carbonate ions are used, is accounted for by the greater symmetry of the cobalti-tricarbonate ion. H. H. HODGSON

541.124

1261. Kinetics and equilibria in the system ferrous ion + ferric ion + hydroquinone + quinone. J. H. BAXENDALE, H. R. HARDY AND L. H. SUTCLIFFE. *Trans Faraday Soc.*, **47**, 963–73 (*Sept.*, 1951).

The reaction mechanism indicated by the dependence of the rates on ferric, ferrous and hydrogen ion concentrations is described. The equilibrium constants for the overall reaction have been obtained

electrometrically and are in good agreement with those calculated from the kinetics. The first and second acid dissociation constants of hydroquinone and the heats of dissociation have been measured. A.

541.124

1262. Kinetics of the exchange reaction between diborane and deuterium. P. C. MAYBURY AND W. S. KOSKI. Letter in *J. Chem. Phys.*, **19**, 1327 (*Oct.*, 1951).

A brief report of studies on the D-diborane exchange appearing to proceed through a complex involving BH_3. F. LACHMAN

541.126

1263. Burning velocity determinations. IV. The soap bubble method of determining burning velocities. J. W. LINNETT, H. S. PICKERING AND P. J. WHEATLEY. *Trans Faraday Soc.*, **47**, 974–80 (*Sept.*, 1951).

For Pt III, see Abstr. 4826 (1951). This includes a rotating drum camera and an apparatus for blowing the soap bubble which contains the explosive gas mixture. Certain tests that have been made of the method are described. The results for some acetylene + air and ethylene + air mixtures at atmospheric pressure are tabulated. These are discussed and compared with results that have been obtained by other methods. A.

541.126

1264. Burning velocity determinations. V. The use of Schlieren photography in determining burning velocities by the burner method. H. R. CONAN AND J. W. LINNETT. *Trans Faraday Soc.*, **47**, 981–8 (*Sept.*, 1951).

It is shown that it seems unsatisfactory to use the luminous cone for burning velocity determinations. Though the Bunsen flame is by no means ideal geometrically, the Schlieren cone should lead to accurate results within the limits of measurement. The present measuring procedure has been tested for ethylene + air mixtures and results are compared with those obtained by other workers. A.

541.126

1265. Burning velocity determinations. VI. The use of Schlieren photography in determining burning velocities by the soap bubble method. H. S. PICKERING AND J. W. LINNETT. *Trans Faraday Soc.*, **47**, 989–92 (*Sept.*, 1951).

The use of Schlieren photography to record the outward movement of a flame initiated in the centre of a mixture contained in a soap bubble is described. The records obtained have been applied to the determination of the burning velocities of one mixture of acetylene and air and of various mixtures of ethylene and air. The results for the ethylene + air mixtures are in good agreement with those obtained by Conan and Linnett who employed Schlieren shadow photographs of the Bunsen inner cone to determine burning velocities by the burner method. A.

541.128

1266. Catalysis by metal powders. D. P. SMITH. Letter in *J. Appl. Phys.*, **22**, 1291–2 (*Oct.*, 1951).

Finely divided metals obtained by ordinary methods are regarded as strained metals in small masses, and some of their properties are explained by their departure from the state of the ideal lattice. F. LACHMAN

ELECTROCHEMISTRY 541.13

541.132

1267. Ion pair formation in thiosulphate solutions. T. O. DENNEY AND C. B. MONK. *Trans Faraday Soc.*, **47**, 992–8 (*Sept.*, 1951).

The solubility of BaS_2O_3 in aqueous solutions of a number of chlorides at 25° has been used to calculate the dissociation constants of the thiosulphates of the corresponding cations. Na and K form the ions MS_2O_3' while the bivalent cations studied form MS_2O_3. An exception to the latter is found with Cd, which forms $Cd(S_2O_3)_2''$ also. Cobalt hexammine also shows two stages of association. Some conductivity measurements for dilute solutions of BaS_2O_3 are reported and the dissociation constant obtained, while an estimate of the second ionization constant of $H_2S_2O_3$ has been derived from *p*H measurements of $Na_2S_2O_3$ solutions containing low concentrations of HCl. The results are compared with the corresponding sulphates, oxalates and malonates, and some evidence is given showing that the dissociation constants of the alkaline earth thiosulphates follow the order of the radii of the hydrated cations. A.

541.133.08

1268. Conductivity measurements with highly dilute aqueous electrolyte solutions. A. DEUBNER AND R. HEISE. *Ann. Phys.* [*Lpz.*] **9**, 213–24 (*No.* 5, 1951) *In German.*

Based on theory and previous data, experimental details are given of a simple method for conductivity measurements in highly dilute (below 10^{-4}N) solutions of electrolytes. Univalent electrolytes (e.g. KCl and NaCl) give results in accord with theory, and afford justification for the method, and divalent electrolytes give linear conductivity curves between 10^{-3}N and 10^{-4}N, but these depart somewhat from linearity at still lower concentrations. The main source of error is inexact knowledge of the conductivity of the solvent water. Some observations on the properties of dissolved CO_2 in water are included. H. H. HODGSON

541.135

1269. The anodic polarization of silver in halide solutions. II. Periodic phenomena occurring during polarization. H. LAL, H. R. THIRSK AND W. F. K. WYNNE-JONES. *Trans Faraday Soc.*, **47**, 999–1006 (*Sept.*, 1951).

For Pt I, see Abstr. 3865 (1951). An account is given of periodic phenomena of a new type occurring during the anodic formation of silver chloride. The conditions for recording them are described and the nature of their dependence on current density, concentration of the chloride solution and temperature. Two possible mechanisms are advanced, one based on the idea of fluctuations of the extent of supersaturation of the solution, and a second based on considerations

of a possible recurrent rupture of the growing silver chloride film. Experimental evidence favours the second explanation. A.

541.135 : 669

1270. The electrodeposition of molybdenum and its alloys. F. W. Salt. *Murex Rev.*, **1**, 201–10 (*No.* 9, 1951).

In a historical review of the subject from 1896 to date with 19 refs., the most important factor involved in Mo deposition appears to be the ratio of moles of water to moles of anion. For formate, acetate and fluoride baths, the limits of the ratio were, severally, 1·6–2·0, 1·8–3·5 and 3·6–6·0. It has been suggested that the lower valence states of Mo, formed during the stepwise reduction from valence 6, are more soluble in the presence of a high anionic concentration than in water, whereby precipitation as a basic salt before final reduction to metal is avoided. Alloys of Mo with Co, Ni and Fe are separately discussed with 5 curves showing effect of *p*H and molybdate concentrations at different c.d.'s. Since the rate of deposition rapidly decreases when the cathode is covered with Mo, it is suggested that unless an electrolyte can be found in which the deposition potential of Mo is much less negative, the low hydrogen overvoltage of Mo will inevitably cause the deposit to be limited in thickness. H. H. HODGSON

541.135.2

1271. Mechanism of the pulverization of electrolytic solutions by the anodic spark. P. Barrett and P. Gérard. *C.R. Acad. Sci.* [*Paris*] **233**, 1090–2 (*No.* 5, 1951) *In French.*

Previous work by Barrett [Abstr. 3140 (1951)] on the ratio between the amount of negative electricity traversing the electrolytic solution in the direction liquid to external electrode and the mass of the solution dispersed in the gaseous phase, is now extended to an investigation of the stage of the spark responsible for the pulverization. Experimental details are included for N . HCl, 2N . NaOH and $NaNO_3$, and the data obtained indicate that pulverization by the anodic spark is due to the short impulse at the period of current establishment, and not to the arc itself. H. H. HODGSON

541.135.5

1272. The role of the cation in the electrical double layer. D. C. Grahame. *J. Electrochem. Soc.*, **98**, 343–50 (*Sept.*, 1951).

The differential capacity of a number of tenth-normal aqueous solutions of metallic chlorides has been measured as a function of potential. The results are interpreted to mean that the solvent sheaths on the positive and negative ions are displaced as the ions approach the interface. New explanations are given for several well-known phenomena connected with the double layer. The surface charge density and integral capacity of the non-diffuse part of the electrical double layer have been calculated from these data. The ratios of the differential capacitances have been found to approach unity at potentials where the concentration of cations within the double layer is at a minimum. A.

541.135.5

1273. The anodic decomposition of hydrogen peroxide. A. Hickling and W. H. Wilson. *J. Electrochem. Soc.*, **98**, 425–33 (*Nov.*, 1951).

In alkaline solution there appears to be a common process, occurring at a low potential, involving the HO_2^- ion, which can be simply formulated as $HO_2^- - 2e = H^+ + O_2$; this takes place rapidly and, in general, the rate of the total anode reaction is governed by diffusion. In neutral and acid solutions this process does not take place at appreciable speed, but there appears to be a common process, occurring at a high potential, which can be formulated as an interaction of the OH radical with the H_2O_2 molecule. Pt anodes in neutral and acid solutions show a specific behaviour. A.

541.135.5 : 621.357.7

1274. Critical interpretation of electrodeposition studies involving traces of elements. J. T. Byrne and L. B. Rogers. *J. Electrochem. Soc.*, **98**, 457–63 (*Nov.*, 1951).

In studies of the deposition of trace amounts of elements, most of the experimental results which have been termed abnormal are really a logical consequence of the assumption that the surface is heterogeneous, and that deposition tends to take place on the more active sites. The lattice sites need not be endowed with specific properties other than those resulting from surface structure. Defining the active centres by relating their binding capacity to the work function of the electrode material is unnecessary and incorrect. A.

541.136

1275. A small volume high tension battery. P. Bristeau. *J. Phys. Radium*, **12**, 74 A–78 A (*Oct.*, 1951) *In French.*

A high tension battery of the Zamboni type is described based on the element $Sn|ZnCl_2|MnO_2|C$, which will maintain certain types of portable electronic apparatus of very low consumption. Its stability is discussed, and the chief operation factors indicated. Some recent applications are cited, viz., for stylo-electroscopes (1 000 V), for portable detectors of γ-rays (750 V), and for ionization chambers (150 V). 6 diagrams and 5 references. H. H. HODGSON

PHOTOCHEMISTRY . RADIATION CHEMISTRY 541.14/.15

541.14

1276. Optical properties at low temperatures of silver bromide with an admixture. O. Stasiw. *Z. Phys.*, **130**, 39–50 (*No.* 1, 1951) *In German.*

Presents results of an investigation on the elementary photochemical process in $AgBr–Ag_2S$ mixed crystals. The measurements, carried out in the temperature range of from −183° to +20°c, have disclosed that only crystals that have acquired the equilibrium arrangement at *c.* 20° show a chemical reaction at low temperatures. It is claimed that the

preliminary stage of colloid formation in crystals has been shown experimentally: a wide colloid band at 620 mμ is formed, even at − 183°C, when the crystals formed at room temperature are irradiated in the region of additional absorption. F. LACHMAN

541.14

1277. Effect of light on the solution in chloroform of iridium-1.2.6-tripyridine trichloride (I). M. DELÉPINE. *C.R. Acad. Sci.* [*Paris*] **233,** 1156–9 (*Nov.* 12, 1951) *In French.*

A solution in chloroform of $IrPy_3Cl_3$ (where $Py = C_5H_5N$), when exposed to the action of light, forms on the walls of the vessel a crystalline deposit consisting of a mixture of $(IrPy_2Cl_3)_n$, $Ir(OH_2)Py_2Cl_3$ and $[IrPy_2Cl_4]PyH$, while free pyridine is separated, and traces of $Cl[IrCl_2(OH_2)Py_3]$ are formed. The same solution remained unchanged in darkness for 5 years. F. LACHMAN

541.14

1278. The photodecomposition of barium azide. J. G. N. THOMAS AND F. C. TOMPKINS. *Proc. Roy. Soc. A,* **209,** 550–61 (*Nov.* 22, 1951).

Results obtained on the rate of photolysis of barium azide and its variation with temperature and light intensity are reported. These are not in accord with Mott's mechanism, and an alternative approach involving the production and trapping of excitons is proposed. A.

541.15

1279. Reduction of carbon dioxide in aqueous solutions by ionizing radiation. W. M. GARRISON, D. C. MORRISON, J. G. HAMILTON, A. A. BENSON AND M. CALVIN. *Science,* **114,** 416–18 (*Oct.* 19, 1951).

C^{14}-labelled CO_2 in aqueous solution is reduced to formic acid under bombardment with 40 MeV helium ions. C. B. ALLSOPP

541.15

1280. Primary reactions produced in water by ionizing radiations. M. HAÏSSINSKY AND M. MAGAT. *C.R. Acad. Sci.* [*Paris*] **233,** 954–6 (*Oct.* 22, 1951) *In French.*

Oxidations by the OH-radicals produced by ionization are more frequent than reductions by the H-atoms, although OH and H should be produced in equal quantities. It is suggested that the primary reaction $H_2O + e \rightarrow H_2 + O^-$ followed by $H_2O + O^- \rightarrow OH + OH^-$ may be important. It would provide 2 OH-radicals plus one H_2-molecule per pair of ions, and would account better for the evolution of H_2 during the irradiation. C. B. ALLSOPP

541.15

1281. X-ray decomposition of dilute solutions of hydrogen peroxide. M. LEFORT. *C.R. Acad. Sci.* [*Paris*] **233,** 1194–5 (*Nov.* 12, 1951) *In French.*

The results of further investigations of the decomposition of dilute solutions of H_2O_2 by X-rays (in which the production of hydrogen has been established) are in accordance with the mechanism proposed by Haïssinsky and Magat [preceding abstract] for dissymmetric production of OH and H radicals from water. C. B. ALLSOPP

541.15

1282. Chemical effects in liquids due to α-particle irradiation. P. I. DEE AND E. W. T. RICHARDS. Letter in *Nature* [*Lond.*] **168,** 736 (*Oct.* 27, 1951).

Irradiation of a thin film of water with α-particles gives rise to quantum radiation which initiates chemical changes in solutions separated from the water by a quartz plate, the effect being about 5% of that obtainable by direct irradiation of the solution. C. B. ALLSOPP

541.15 : 541.182.6

1283. Actions of ionizing radiations on colloidal solutions. M. HAÏSSINSKY AND W. GLUZBARG. *C.R. Acad. Sci.* [*Paris*] **233,** 1192–4 (*Nov.* 12, 1951) *In French.*

Results of qualitative experiments on the coagulation and stabilization of colloidal solutions under irradiation with gamma-rays, gamma-rays and neutrons, and neutrons alone are described, and an attempt is made to interpret them in terms of formation of hydroxyl radicals and hydrogen atoms. C. B. ALLSOPP

DISPERSIONS . COLLOIDS . ADSORPTION
541.18

541.18.041

1284. The acid decomposition of sodium thiosulfate. M. KERKER. Letter in *J. Chem. Phys.,* **19,** 1324–5 (*Oct.,* 1951).

The induction period, t_B, of precipitation of colloidal S from acid decomposition of $Na_2S_2O_3$ has been re-determined as a function of initial concentration by observing the increase in optical density. F. LACHMAN

541.182.5/.6

1285. Mechanical properties and structure of sol-type and gel-type gelatine films. E. BRADBURY AND C. MARTIN. Letter in *Nature* [*Lond.*] **168,** 837–8 (*Nov.* 10, 1951).

541.183

1286. The heat capacity, integral heat of adsorption and entropy of argon adsorbed on titanium dioxide. J. A. MORRISON, J. M. LOS AND L. E. DRAIN. *Trans Faraday Soc.,* **47,** 1023–30 (*Sept.,* 1951).

Direct measurements of the heat capacity of A adsorbed at three low concentrations on TiO_2 have been made in the temperature range 14° to 105°K. At higher temperatures, up to 130°K the heat capacity of the adsorbed argon has been determined from the temperature coefficient of the integral heat of adsorption. Between 14° and 25°K the heat capacity appears to be that of a three-dimensional oscillator in agreement with the idea of localization at these temperatures. At the higher temperatures the heat capacity rises to values much larger than can be accounted for on the basis of any simple model of the adsorbed phase. The zero-point entropy of the adsorbed A has been calculated at three concentrations and found to be zero within experimental error. A reasonable interpretation of this result is that the solid surface is heterogeneous energetically. A.

541.183

1287. Adsorption of water vapour on solid surfaces. F. P. Bowden and W. R. Throssell. *Proc. Roy. Soc. A*, **209**, 297–308 (*Nov.* 7, 1951).

Two methods are used, the first a direct weighing of the adsorbed film on a microbalance and the second an examination of polarized light reflected from the surface. Both methods agree and show that, for the surfaces examined, the adsorption of water at vapour pressures near saturation corresponds only to about two molecular layers. The experiments suggest that the heavy adsorption, which has been previously observed and which has been quoted as evidence for long-range surface effects, is due to contamination. A.

541.183

1288. Hüttig's adsorption isotherm. O. Theimer. Letter in *Nature* [*Lond.*] **168**, 873 (*Nov.* 17, 1951).

A new isotherm equation (A) is derived on the basis of a model which involves the formation both of multimolecular layers and of two-dimensional clusters; (A) includes the Brunauer–Emmett–Teller and the Hüttig isotherms as limiting cases. S. J. Gregg

541.183 : 536.75

1289. Thermodynamic data and some notes on the nature of adsorbed helium. S. V. R. Mastrangelo and J. G. Aston. *J. Chem. Phys.*, **19**, 1370–5 (*Nov.*, 1951).

The adsorption isotherms and heat capacities of helium on TiO_2 in the rutile crystalline form have been obtained. On the basis of the observed shift in lambda-point with coverage, the behaviour of the adsorbed phase has been correlated with the behaviour of the bulk liquid and solid under pressure. A.

541.183 : 537.533.74

1290. The use of the field emission electron microscope in adsorption studies of W on W and Ba on W. J. A. Becker. *Bell Syst. Tech. J.*, **30**, 907–32 (*Oct.* (I) 1951).

The adsorption properties of W on W and Ba on W vary with the crystal plane and are given for five planes. The adsorption properties of Ba on W for the first layer are quite different from those for subsequent layers. In the first layer for which $\theta \leqslant 1$, Ba forms two phases: a condensed phase in which the Ba forms clusters or islands having a median diameter of 100×10^{-8} cm, and a dispersed phase consisting of individual atoms. For more than one layer of Ba on W, the Ba forms crystallites which grow outward from the W surface even at room T. Their median diameter is about 400×10^{-8} cm and they disappear between 600 and 800°K. A.

541.183.5 : 532.696.1

1291. Relationship between the heat of wetting and the adsorbability of liquid organic compounds by solid surfaces. L. Robert. *C.R. Acad. Sci.* [*Paris*] **233** 1103–4 (*Nov.* 5, 1951) *In French.*

Presents the results of a calorimetric determination of the heats of wetting of the gels of silica and alumina by a dozen liquid organic compounds (and water). The heats are expressed in cal/m² or erg/cm²; the specific areas of the gels used were 690 m²/g for silica, and 150 m²/g for alumina. It is assumed that the heat of wetting figures (cal/m²) can represent the absolute values of the degree of adsorption of a liquid by a solid. It has also been found that the heat of wetting of alumina gel by water and C_2H_5OH depends to a large extent upon the temperature of the heat treatment (activation) of the gel. F. Lachman

CHEMICAL STRUCTURE 541.2/.6

541.57: 548.736.3

1292. The covalent bond length of mercury-chlorine. D. Grdenić. *Arh. Kemi.*, **22**, 14–25 (1950) *In Croatian.—Summary in English.*

The results of Braekken and Scholten [*Z. Krist*, **89**, 448–55 (*Nov.*, 1934)] for $HgCl_2$ are confirmed, and the atomic parameters refined to $y = 0{\cdot}126 \pm 2$, $z = 0{\cdot}050 \pm 4$ for the Hg atom and $y = 0{\cdot}255$, $0{\cdot}496 \pm 5$; $z = 0{\cdot}406$, $0{\cdot}806 \pm 15$, respectively, for the Cl atoms, leading to an Hg–Cl distance of 2·25 Å. Oscillation photographs about [100] and microphotometry were used. The covalent Hg–Cl distance in various compounds is discussed. In Hg_2Cl_2, CH_3HgCl and C_2H_5HgCl it is about 2·50 Å, slightly more than the sum (2·47 Å) of the accepted covalent atomic radii, whereas in $HgCl_2$ and HgCl [dissociated Hg_2Cl_2 vapour; see *Phys. Rev.*, **57**, 21–3 (*Jan.* 1, 1940)] it is about 2·25Å. A. J. C. Wilson

541.57

1293. The structure of carbon suboxide by the method of electron diffraction. H. Mackle and L. E. Sutton. *Trans Faraday Soc.*, **47**, 937–42 (*Sept.*, 1951).

The electron scattering by carbon suboxide has been re-examined; and further orders of diffraction have been recorded. The following values for the bond lengths have been obtained by trial-and-error analysis based on linear structures: carbon-oxygen = $1{\cdot}19 \pm 0{\cdot}03$ Å; carbon-carbon = $1{\cdot}28 \pm 0{\cdot}03$ Å. Certain non-linear structures have also been tested and the results indicate that appreciable deviation from linearity is unlikely. The spectroscopic and dipole moment measurements, which initially suggested non-linearity, are reviewed, and an alternative interpretation of them is offered. A.

541.57

1294. The germanium-fluorine bond length in germanium tetrafluoride. A. D. Caunt, H. Mackle and L. E. Sutton. *Trans Faraday Soc.*, **47**, 943–5 (*Sept.*, 1951).

Electron diffraction measurements on GeF_4 gas are described, and a value of $1{\cdot}67 \pm 0{\cdot}03$ Å for the Ge–F distance is reported. This value is smaller than that predicted by the covalent radii additivity rule, and the contraction is compared with those shown by bonds between fluorine and certain other elements in the first three rows of the periodic table. Deviations from the Schomaker–Stevenson rule are considered. A.

541.67

1295. The diamagnetic susceptibility of free radicals and aromatic biradicals. A. Pullman and G. Berthier. *C.R. Acad. Sci.* [*Paris*] **233**, 1035–7 (*Oct.* 29, 1951) *In French.*

Dissociation of the arylethanes into free radicals

is generally accompanied by diminution of diamagnetic anisotropy. The anisotropy of the biradical *m*-diphenoquinodimethane is less than that of the *p*-isomer where the free electrons are lost in the formation of the quinonoid structure. W. R. ANGUS

541.67

1296. Contribution to the study of a magneto-chemical systematic. P. PASCAL, A. PACAULT AND J. HOARAU. *C.R. Acad. Sci.* [*Paris*] **233,** 1078–80 (*Nov.* 5, 1951) *In French.*

From experimentally determined values of the molar diamagnetic susceptibilities ($-\chi_m$) of a large number of organic compounds, the following atomic and group susceptibilities have been deduced (all in $-\chi_m 10^6$ units) CH_2, 11·4; H, 2·0; C, 7·4; O, 5·3; CO_2, 15·1; S, 16·9; N, 9·0; Cl, 18·5; Br, 27·8; I, 42·2; λ (benzene), 15·1; λ (double bond), − 5·5. Several C–X bond susceptibilities have also been derived. W. R. ANGUS

541.68

1297. Volume effects in non-polar liquid mixtures. W. SCHULZE. *Z. phys. Chem.*, **197,** 63–74 (*No.* 1–2, 1951) *In German.*

Presents the results of density determinations carried out at 25°C for the systems: tetraisopropyl stannate (TIPS)–C_6H_6, TIPS–CCl_4, and TIPS–cyclohexane. It has been shown that the value of the molar limiting volume effect enables conclusions to be drawn regarding the structure of molecule packing in C_6H_6, CCl_4, and cyclohexane. F. LACHMAN

CHEMICAL PROCESSES 542.9

542.952.7 : 535.33.07–15

1298. Study of degradation of polystyrene, using infrared spectrophotometry. B. G. ACHHAMMER, M. J. REINEY AND F. W. REINHART. *J. Res. Nat. Bur. Stand.* [*Wash.*] **47,** 116–25 (*Aug.*, 1951).

Polystyrene films were exposed to heat at 100°C in a forced-draught air oven and to ultraviolet radiant energy at 60°C in air. Chemical structural changes in the polymer as a result of these treatments were analysed by study of the i.r. spectra between 2 and 16 microns, obtained with a Baird recording i.r. spectrophotometer. Ultraviolet exposure for 200 hr resulted in absorptions at 2·9 and 5·8 microns, which are attributed to hydroxyl and carbonyl groups, respectively. Heating of the film for 270 hr at 100°C produced no significant change in the i.r. spectrum. Prolonged heating at 125°C resulted in the destruction of the films by flow. The literature and theory on the degradation of polystyrene are discussed. Several mechanisms are postulated to account for the production of hydroxyl and carbonyl products in the polymer. A.

CHEMICAL ANALYSIS 543/545

544.824

1299. Topological microanalysis with X-rays. M. PAIC. *J. Phys. Radium,* **12,** 41A–52A (*Oct.*, 1951) *In French.*

Discusses the application of radiography and microradiography to the analysis of the specimen. An approximate theory of the procedure is given for the case of certain types of binary alloy, and the choice of a suitable X-ray wavelength is considered. The influence of diffuse scattered radiation and of the characteristics of X-ray emulsions are also discussed. Examples of the application of this technique are given and it is shown that as little as 10^{-5} g of Cu may be detected. A. E. DE BARR

545.8

1300. Analysis of traces of sodium, copper and rare earths in very pure aluminium by the radioactive pile activation method. P. ALBERT, M. CARON AND G. CHAUDRON. *C.R. Acad. Sci.* [*Paris*] **233,** 1108–10 (*Nov.* 5, 1951) *In French.*

By standardization of this method against samples of known metal content, it was shown that 99·998% Al contained approx. 4×10^{-6}% Na, and 2×10^{-6}% Cu. The action of a stream of thermal neutrons on 1 g of sample for 6 hr converts the Na and Cu into radioactive Na_{24} and Cu_{64}, respectively. Chemical methods of preliminary separation used are described. The dehydration of boehmite was also studied, and the absence of an amorphous phase established. J. GRANT

545.8 : 539.185

1301. Chemical analysis by neutron spectroscopy. T. I. TAYLOR, R. H. ANDERSON AND W. W. HAVENS, JR. *Science,* **114,** 341–55 (*Oct.* 5, 1951).

Outlines the properties of neutrons and their interactions with matter; and discusses analysis by resonance absorption and scattering, simple transmission, absorption of thermal neutrons and neutron activation. J. THEWLIS

545.8 : 539.62

A study of metal transfer during sliding, using radio-activation counters. *See Abstr.* 1258

545.82

1302. Spectrochemical analysis of siderurgical slags. Preparation of synthetic standards by fritting. R. CASTRO AND R. LOUDE. *C.R. Acad. Sci.* [*Paris*] **233,** 1031–3 (*Oct.* 29, 1951) *In French.*

Heterogeneity in synthetic standards made by fusing together a mixture of appropriate substances in the desired proportions can give misleading results in spectrochemical analysis. Such difficulties are overcome by grinding the mixture finely, and heating it at 1 200° in a Pt dish for several hours, and again grinding the resulting hard mass. The analyses were made by exciting a 5–10% mixture of the sample with pure Ni powder with a unidirectional pulsating arc, with a pure graphite counter-electrode. J. GRANT

CRYSTALLOGRAPHY 548

548.0 : 535.37 : 537.312.5

1303. Coloration and luminescence due to Becquerel rays together with related phenomena. K. PRZIBRAM. *Z. Phys.*, **130**, 269–92 (*No.* 3, 1951) *In German.*

A review of recent work on coloration, luminescence and other related effects, such as triboluminescence and photoconductivity, in various materials. These include rock salt, alkali metal borates and fluorites.

G. F. J. GARLICK

548.0 : 539.373

1304. The phenomenon of artificial displacement. IV. The growth of centres of slip. A. V. STEPANOV AND E. A. MÎLKAMANOVICH. *Zh. Eksper. Teor. Fiz.*, **21**, 401–8 (*No.* 3, 1951) *In Russian.*

For Pt III, see Abstr. 1227 (1949). Descriptive. Slip in the direction [110] of the planes (110) was produced in crystals of rock salt by the application of a mechanical tension. The process was filmed and about 40 frames are reproduced to illustrate the phenomenon. The temperature was varied and the stress necessary to cause slip followed the change of elastic limit with temperature. A. L. MACKAY

548.0 : 539.373

1305. The phenomenon of artificial displacement. V. The influence of solution on artificial slip formation. A. V. STEPANOV AND E. A. MÎLKAMANOVICH. *Zh. Eksper. Teor. Fiz.*, **21**, 409–12 (*No.* 3, 1951) *In Russian.*

Numerous experiments are described with photographs showing that the action of a solvent on the surface of a crystal of rock salt affects the spreading of faults into the volume of the crystal. The experiments continue the study described by A. V. Stepanov [*Zh. Eksper. Teor. Fiz.*, **17**, 601 (1947)]. A scratch was made on the wet surface of the crystal with a diamond and tension was applied until slipping began. Layers of various thickness were dissolved off the crystal which was examined in polarized light.

A. L. MACKAY

548.12

1306. Space-group symmetry and methods of crystal-structure calculation. II. A. NIGGLI AND P. NIGGLI. *Z. angew. Math. Phys.*, **2**, 311–36 (*No.* 5, 1951) *In German.*

For Pt I, see Abstr. 9806 (1951). The calculation of electron-density distributions and Patterson maps involves the summation of cosine and sine terms of the form $\begin{matrix}\cos\\ \sin\end{matrix} 2\pi hx \begin{matrix}\cos\\ \sin\end{matrix} 2\pi ky \begin{matrix}\cos\\ \sin\end{matrix} 2\pi lz$. A tabular method is given for obtaining the terms appropriate to any given space-group. A. R. STOKES

548.232.2

1307. The macromosaic structure of tin single crystals. E. TEGHTSOONIAN AND B. CHALMERS. *Canad. J. Phys.*, **29**, 370–81 (*Sept.*, 1951).

Single crystals of high purity tin grown from the melt by a modified Bridgman method are shown to be partitioned into bands, or striations. A difference of orientation exists between the striations such that the lattice of one striation may be brought into coincidence with the lattice of its neighbour by a pure rotation about an axis parallel to the specimen axis. The properties of the striations have been shown to be dependent on both the rate of growth and the crystallographic orientation relative to the direction of heat flow. A tentative explanation of the origin of this effect is advanced in terms of the formation of edge type dislocations from the condensation of vacant lattice sites. A.

548.24

1308. Detwinning ferroelectric crystals. E. A. WOOD. *Bell Syst. Tech. J.*, **30**, 945–55 [*Oct.* (I) 1951].

Unstrained single crystals of $BaTiO_3$ can be detwinned under the influence of an electric field at elevated temperature, but strained crystals cannot. It seems probable that this is also true of crystals in a polycrystalline body such as a ceramic. A.

548.33

1309. Polymorphism of cesium and thallium halides. L. G. SCHULZ. *Acta Cryst.*, **4**, 487–9 (*Nov.*, 1951).

Six salts (CsCl, CsBr, CsI, TlCl, TlBr and TlI) which normally have the CsCl-type crystal structure were found to have the NaCl-type structure when grown from the vapour phase on appropriate single-crystal substrates. The lattice constants of the new structures were measured by electron-diffraction methods to an accuracy of $\pm$ 0·02 Å. A.

548.33

1310. Polymorphism arising from screw dislocation. V. VAND. Letter in *Nature* [*Lond.*] **168**, 783 (*Nov.* 3, 1951).

Polymorphism due to screw dislocations occurs in layer structures when certain energy conditions are fulfilled. Large crystals of a polymorphic form occur when screw dislocations are very stable. See Abstr. 9811 (1951). J. A. FRANKS

548.4

1311. Capillary equilibria of dislocated crystals. F. C. FRANK. *Acta Cryst.*, **4**, 497–501 (*Nov.*, 1951).

It is shown that a dislocation whose Burgers vector exceeds a critical value, of the order of magnitude 10 Å, is only in equilibrium with an empty tube at its core. This is not the case in metals or other simple crystalline solids, but is likely to be the case in protein crystals, which therefore, unfortunately, do not provide good models of simple crystalline substances in respect of dislocations. The same causes generally give rise to a dimple or crater where a dislocation meets a free surface, and the shape of this crater is calculated. Though shallow in form, it is infinitely deep except at a habit face of a crystal, where it is of finite depth and may be totally absent. A.

548.5

1312. Dendritic growth in lead. F. WEINBERG AND B. CHALMERS. *Canad. J. Phys.*, **29**, 382–92 (*Sept.*, 1951).

Dendritic growth of large single crystals of Pb is revealed by decanting the remaining liquid at any required stage of the process of solidification. The direction of dendritic growth was determined as a function of crystallographic orientation and direction of solidification. It was found that all the dendritic rows in a single crystal were not quite parallel, owing

to a crystal substructure. An explanation is advanced for the presence of the substructure in terms of dendritic growth based on their observed properties. Temperature measurements during solidification showed that the region of the liquid where dendrites were formed was supercooled by several degrees. No supercooling was observed in the portions not showing dendritic growth. A.

548.5

1313. Processes in supersaturated mixed crystals. U. DEHLINGER. *Z. Naturforsch.*, **6a**, 718–21 (*Nov.*, 1951) *In German.*

It has been deduced thermodynamically that the diffusion coefficient becomes negative in supersaturated mixed crystals, owing to which complexes are formed. The size of the complexes is limited by the concomitant stresses, and it decreases as temperature rises. It is possible to estimate statistically the average time of formation for a given complex size. F. LACHMAN

548.52

1314. Growth spiral patterns on carborundum crystals. A. R. VERMA. Letter in *Nature* [*Lond.*] **168**, 783–4 (*Nov.* 3, 1951).

See Abstr. 9810, 9812–13 (1951). New growth spiral features have been observed, such as the regular spacing of groups of steps, and the occurrence of spots either at the edges of steps or unattached to spirals. J. A. FRANKS

548.538

1315. Growth of alkali halide crystals from the vapor phase and from solution onto substrates of mica. L. G. SCHULZ. *Acta Cryst.*, **4**, 483–6 (*Nov.*, 1951).

Thin films of eleven alkali halides were formed by evaporation in a vacuum on mica substrates and were studied by means of electron diffraction. The crystals of all substances had a [111] direction normal to the substrate. In addition, there was an angular orientation about this direction which depended on the lattice constant, a_0, in the following way: (1) When a_0 was $>5{\cdot}32$ Å (a_0 for KF) the angular orientation of the hexagonal net of atoms in the deposit at the interface matched exactly the orientation of the network of K atoms in the cleavage face of mica. (2) For LiCl ($a_0 = 5{\cdot}14$ Å) the angular orientation was random, but the [111] fibre structure was well defined. (3) NaF ($a_0 = 4{\cdot}62$ Å) had a [111] fibre structure but was mixed with a component of crystals having random orientation. (4) For LiF ($a_0 = 4{\cdot}02$ Å) the hexagonal network at the interface was turned 30° in respect to the K network of the substrate. Almost identical results were obtained when the crystals were grown from solution. Substances which closely matched the interatomic spacing of the substrate gave support to a monolayer hypothesis of crystal growth from the vapour, whereas substances for which the mismatch exceeded about 10% began growth according to an oriented-nucleus hypothesis. A.

548.54

1316. Modification of crystal habit of inorganic salts with dyes. J. WHETSTONE. Letter in *Nature* [*Lond.*] **168**, 663–4 (*Oct.* 13, 1951).

Conditions are given for dyes to have strong crystal habit modifying properties for a particular salt. J. A. FRANKS

MOLECULAR AND X-RAY CRYSTALLOGRAPHY 548.7

548.7

1317. On the accuracy of the method of effective mass in the theory of localized states of electrons in a crystal. K. B. TOLPYGO. *Zh. Eksper. Teor. Fiz.*, **21**, 443–53 (*No.* 3, 1951) *In Russian.*

Superposition on the periodic potential V of an additional potential $W(r)$ leads generally to an integro-differential equation, in which the energy of the zonal electron plays the role of kinetic energy operator. If $W(r)$ can be expanded in series within each cell, the equation reduces, in the approximation of bound electrons, to one of Slater type. Polarons can be treated as electrons localized on a lattice cation. J. JACOBS

548.7

1318. Scattering of polaron-waves by acoustical vibration of a crystal lattice. YU. E. PERLIN. *Zh. Eksper. Teor. Fiz.*, **21**, 547–54 (*No.* 4, 1951) *In Russian.*

The exchange term with polarization longitudinal waves has hitherto been treated as perturbation allowing transitions between stationary states of the conduction zone. However, this term is not small so that some solutions of Schrödinger's equation with periodic potential are incorrect zeroth approximations. The mobility of polarons is discussed and the conditions under which exchange effects with acoustical vibrations assume significance in scattering. J. JACOBS

548.7

1319. Use of the scattering-matrix method in the determination of the electronic properties of a three dimensional crystal. R. J. HARRISON. Letter in *Phys. Rev.*, **84**, 377 (*Oct.* 15, 1951).

548.7

1320. A chemical determination of "tetrahedral" and "octahedral" aluminium ions in a silicate. G. W. BRINDLEY AND R. F. YOUELL. *Acta Cryst.*, **4**, 495–6 (*Nov.*, 1951).

548.7

1321. Note on the hydrogen-deuterium isotope effect in crystals. C. E. NORDMAN AND W. N. LIPSCOMB. Letter in *J. Chem. Phys.*, **19**, 1422 (*Nov.*, 1951).

An attempt at explaining the H–D isotope effects in crystals by considering the difference between the probability distribution functions for H and D. F. LACHMAN

548.7 : 535.43

1322. The polarization of Rayleigh scattering as an aid to the determination of molecular orientation in solids. E. G. COX. Letter in *J. Chem. Phys.*, **19**, 1325 (*Oct.*, 1951).

A knowledge of space group, density and refractive indices of a crystalline substance, together with the molecular refraction and Rayleigh polarization admit an estimate of the molecular orientation. J. JACOBS

548.7 : 535.662

1323. The coloration of MgO crystals by lattice structure. H. WEBER. *Z. Phys.*, **130**, 392–402 (*No.* 3, 1951) *In German.*

Absorption spectra of magnesium oxide crystals coloured by heating in the vapour of either lattice constituent or by irradiation with X-rays or u.v.

radiation are measured. Rates of diffusion of oxygen into the crystals are also investigated. G. J. F. GARLICK

548.7 : 537.311.32

1324. Thermal destruction of V_1 centers in potassium chloride. D. DUTTON, W. HELLER AND R. MAURER. Letter in *Phys. Rev.*, **84**, 363 (*Oct.* 15, 1951).

Experiments are described which support Seitz's theory [Abstr. 9113 (1950)] on the origin of the V_1 absorption band. The small activation energy found for the release of a +ve hole from a +ve ion vacancy, $\frac{1}{10}$th the optical activation energy, is understandable on Seitz's model. A. D. LE CLAIRE

548.7 : 539.152.2

Theory of spin-lattice equilibrium in molecular crystals. *See Abstr.* 1170–1

548.7 : 539.32 : 539.11

Elastic constants of alkali halide crystals. *See Abstr.* 1142

548.73

1325. A second water structure for inert gas hydrates. W. F. CLAUSSEN. Letter in *J. Chem. Phys.*, **19**, 1425–6 (*Nov.*, 1951).

The structure is body-centred cubic, cell constant 12 Å, consisting of pentagonal dodecahedral arrays of 20 water molecules each. It contains voids smaller than those of the first structure [Abstr. 5907 (1951)]. A. R. STOKES

548.73 : 535.43 : 537.531

X-ray scattering by aggregates of bonded atoms. I. Analytical approximations in single-atom scattering. *See Abstr.* 1042

548.73/.74 : 539.26/.27

X-ray and electron investigation of materials. *See Abstr.* 1232–7

548.733

1326. A simple two-crystal spectrometer made for investigating crystal lattices. G. BROGREN. *Ark. Fys.*, **3**, 507–14 (*Paper* 29, 1951).

The construction and adjustments are fully described. A. R. STOKES

548.733

1327. A new type of crystal holders for focussing X-ray spectrometers. G. BROGREN. *Ark. Fys.*, **3**, 515–18 (*Paper* 30, 1951).

The crystal is bent by applying opposite couples at its ends. The construction of an adjustable holder is described. A. R. STOKES

548.733 : 537.531

1328. Suggested device for the production of a monochromatic divergent beam. H. J. GRENVILLE-WELLS. *Acta Cryst.*, **4**, 563–4 (*Nov.*, 1951).

548.734

1329. The Lorentz factor for the Buerger precession method. J. WASER. *Rev. Sci. Instrum.*, **22**, 563–6 (*Aug.*, 1951).

See Abstr. 3579 (1949). The Lorentz factor for the Buerger precession method is derived. It turns out that the angular velocity of the motion of the reciprocal lattice through the sphere of reflection is not uniform as hitherto accepted. The Lorentz factor thus depends explicitly on all three cylindrical co-ordinates ξ, ζ, τ of the reciprocal lattice point under consideration and not on only ξ and ζ. A.

548.734

1330. Lorentz and polarization correction for the Buerger precession method. J. WASER. *Rev. Sci. Instrum.*, **22**, 567–8 (*Aug.*, 1951).

The reciprocal of the product of the Lorentz factor and the polarization factor is calculated for the zero level and $\bar{\mu} = 30°$. A.

548.734.3

1331. The determination of interplanar spacings and cell dimensions from powder photographs using an internal standard. K. W. ANDREWS. *Acta Cryst.*, **4**, 562–3 (*Nov.*, 1951).

548.735.42

1332. On the use of Harker–Kasper inequalities. E. GRISON. *Acta Cryst.*, **4**, 489–90 (*Nov.*, 1951) *In French.*

The various limits set by Harker–Kasper inequalities are compared. It is shown that the simple inequality $(U_H \pm U_{H'})^2 \leqslant (1 \pm U_{H+H'})(1 \pm U_{H-H'})$ is the most powerful. A table is given for its systematic use. A.

548.735.42

1333. Phase-determining relations based on a knowledge of the electron-density function in parts of the unit cell. J. A. GOEDKOOP, C. H. MACGILLAVRY AND R. PEPINSKY. *Acta Cryst.*, **4**, 491–2 (*Nov.*, 1951).

A general relation between structure factors is derived for the case where the electron density is known in parts of the unit cell. Some special cases are discussed briefly. Also, it is shown that no information about the phases can be obtained from the fact that interatomic distances are known to exceed a certain minimum. A.

548.735.46

1334. A new approach to crystal-structure analysis. M. J. BUERGER. *Acta Cryst.*, **4**, 531–44 (*Nov.*, 1951).

In order to apply vector-set methods to the solution of Patterson syntheses, it is first pointed out that the Patterson synthesis is the vector set of the electron density provided that the Patterson function is defined as an integral and not as an average of the electron-density product. With this proviso, vector-set methods can be applied to solve the Patterson synthesis for the electron density. The most appropriate vector-set method is the synthesis of the vector-set points into n identical n-gons. To do this with Patterson syntheses, one sets up a function of the Patterson values at the vertices of an image polygon, called an image-seeking function. Such a function has the property of attaining a high value when the polygon is in image position, but zero when it is not. Two such functions have been proposed, a product function and a minimum function. The properties of these functions are discussed. These functions bear an inequality relation to the electron density, and the inequality is strengthened by combining functions to produce others of greater rank. Application of this theory leads to a map of the function which is essentially an approximate map of the electron density. The theory is illustrated by application to the solution of the structure of berthierite, $FeSb_2S_4$, from its Patterson projection. By combining maps of the minimum function for this crystal, one of rank 8 is readily attained which is sufficiently close to the

electron density so that seven atoms in the asymmetrical unit are clearly distinguished. These have peaks of relative ranks 4 : 2 : 1, which is approximately the relative electron counts of Sb, Fe and S, respectively. The relation between these methods and those of Clastre and Gay, Garrido, Robertson, and McLachlan, is briefly discussed. The methods of these authors are the equivalents of image methods as applied to sets of discrete points, although a different language is used to describe them. They have not advanced beyond methods for decomposing vector sets of discrete points, and cannot be expected to solve typical Patterson syntheses. A.

548.736.1

1335. Amorphous arsenic. H. Richter and G. Breitling. *Z. Naturforsch.*, **6a**, 721–41 (*Nov.*, 1951) *In German.*

Twelve samples of amorphous arsenic in various states were obtained by heat-treatment or chemical precipitation. The scattering of monochromatic Cu$K\alpha$ radiation was recorded photographically and corrected for absorption, incoherent scattering, etc. Lattice constants were derived, and radial Fourier transforms were used to give atomic positions. A chain structure is proposed, which explains the observed change in scattering on going from very thin particles ($\sim 10^{-5}$ cm) to thicker particles.

A. R. STOKES

548.736.1

1336. The interlayer spacing of graphite. G. E. Bacon. *Acta Cryst.*, **4**, 558–61 (*Nov.*, 1951).

From a study of well-crystallized graphites direct evidence is obtained of the different spacings between oriented and disoriented layers, respectively, in a stack of parallel graphite layers. It is shown that when the proportion of disoriented layers is small there is practically a linear relation, with the mean interlayer spacing deduced from 000*l* lines. A.

548.736.1

1337. The *a* dimension of graphite. G. E. Bacon and R. E. Franklin. *Acta Cryst.*, **4**, 561–2 (*Nov.*, 1951).

548.736.3

1338. Disturbance spots caused in chalcogenides of alkali earth metals by the insertion of rare earths. P. Brauer. *Z. Naturforsch.*, **6a**, 562–3 (*Oct.*, 1951) *In German.*

An attempt at explaining the presence of Eu in the form of Eu^{+++} in the oxides and in the form of Eu^{++} in the sulphides of alkali earth metals, based on the approximately calculated energy of the reduction of Eu^{+++} to Eu^{++} with the assumption of the charge-compensating supplementary disturbance places (Schottky's cationic holes). See also Abstr. 873 (1952). F. LACHMAN

548.736.3

1339. The crystal structure of chromium (II) chloride. L. L. Handy and N. W. Gregory. Letter in *J. Chem. Phys.*, **19**, 1314 (*Oct.*, 1951).

Powder pattern spacings and intensities are given. $CrCl_2$ is orthorhombic, with $a = 6{\cdot}65$, $b = 5{\cdot}99$, $c = 3{\cdot}48$ Å. A. R. STOKES

548.736.3

1340. Structure of $Cu_{32}Al_{19}$. A. J. Bradley. Letter in *Nature* [*Lond.*] **168**, 661 (*Oct.* 13, 1951).

A discussion of the degradation of symmetry, in relation to the numbers of atoms and free electrons per unit cell, in passing from $Cu_{34}Al_{18}$ (cubic) to $Cu_{30}Al_{20}$ (? rhombohedral). A. R. STOKES

548.736.3

1341. Diffuse scattering by an ordering alloy. J. B. Newkirk, R. Smoluchowski, A. H. Geisler and D. L. Martin. *Acta Cryst.*, **4**, 507–12 (*Nov.*, 1951).

At an early stage of the ordering reaction process in CoPt crystals, thin platelets of the ordered phase form on {110} planes of the disordered matrix phase. These platelets are coherent with the matrix. Since {110} planes of the two phases are not identical, when each is in an unstrained condition, they mutually strain each other, causing characteristic diffuse X-ray diffraction effects and the marked changes in physical properties previously reported. [Abstr. 3911 (1951)]. A.

548.736.3

1342. The lattice constant of caesium iodide. T. B. Rymer and P. G. Hambling. *Acta Cryst.*, **4**, 565 (*Nov.*, 1951).

Value at 20°C = 4·5667 Å. Linear coeff. of thermal expansion between 22° and 36°C = $4{\cdot}86\times10^{-5}$.

548.736.3

1343. The molecular and crystal structure of nitric oxide dimer. W. J. Dulmage, E. A. Meyers and W. N. Lipscombe. Letter in *J. Chem. Phys.*, **19**, 1432–3 (*Nov.*, 1951).

The N_2O_2 molecule forms a rectangle, 2·38 Å by 1·10 Å. Its residual entropy is accounted for by two possible orientations. A. R. STOKES

548.736.4

1344. Pseudo-cubic alkaline-earth tungstates and molybdates of the R_3MX_6 type. E. G. Steward and H. P. Rooksby. *Acta Cryst.*, **4**, 503–7 (*Nov.*, 1951).

548.736.4 : 537.226.2

1345. The structure of ferroelectric sodium niobate at room temperature. P. Vousden. *Acta Cryst.*, **4**, 545–51 (*Nov.*, 1951).

Single crystals have been studied by X-ray diffraction. The unit cell is orthorhombic with dimensions $5{\cdot}5682\times15{\cdot}5180\times5{\cdot}5052$ Å, and contains 40 atoms. The space group is $P22_12$. A very unexpected feature of the structure is that the Nb ions are displaced from the special positions in the ideal perovskite structure by 0·11 Å in opposite directions along the *a* axis. This axis is equivalent to the polar axis in orthorhombic $BaTiO_3$, and the result that the structure is non-polar is in contradiction to the generally accepted theory of the spontaneous polarization of this group of ferroelectric substances. A general consideration of the factors determining the space group of any pseudosymmetrical compound leads to an explanation of the space group and unit-cell size. A similar orthorhombic distortion, accompanied by atom displacements, occurs in certain other non-ferroelectric perovskite-type compounds in which there is a misfit of packing of the atoms. This suggests that, as a similar misfit occurs in $NaNbO_3$, the

displacements can be described in terms of this misfit of the atomic radii in the structure, and that the orthorhombic distortion which results from the ferroelectricity would therefore lower the energy associated with these displacements. The shifts cannot, however, be completely explained in terms of these packing considerations alone, but can be accounted for if there is in addition an appreciable proportion of homopolar bonding between the niobium and oxygen atoms. A.

548.736.4

1346. The crystal structure of K_2SbF_5 and isomorphous compounds. A. BYSTRÖM AND K.-A. WILHELMI. *Ark. Kemi*, **3**, 461–7 (*Paper* 50, 1951).

Orthorhombic, space group *Cmcm* if crystal class *mmm*, $Z = 4$. The cell dimensions are

Anión	a	b	c
K	6·244 ± 5	13·67 ± 1	6·491 ± 5 Å
Rb	6·339	13·88	6·745
Cs	6·652	14·45	7·099
NH_4	6·489	14·09	6·710
Tl	6·470	14·05	6·710

A detailed determination on the K compound shows that the metal atoms are in 4(*c*), with $y = -0{\cdot}089 \pm 3$ for Sb, $0{\cdot}250 \pm 5$ and $0{\cdot}578 \pm 5$ for K. The F atoms are in 4(*c*) with $y = -0{\cdot}241$ and 16(*h*) with $x = 0{\cdot}222$, $y = 0{\cdot}111$, $z = -0{\cdot}028$, all $\pm 0{\cdot}01$. $KSbF_4$ is orthorhombic, with $a = 16{\cdot}3$, $b = 11{\cdot}6$, $c = 4{\cdot}5$ Å, $Z = 8$; $RbSbF_4$ is monoclinic, with $a = 23{\cdot}3$, $b = 6{\cdot}2$, $c = 4{\cdot}6$ Å, $\beta = 90°$, $Z = 6$; and KSb_2F_7 is monoclinic, with $a = 10{\cdot}6$, $b = 7{\cdot}7$, $c = 8{\cdot}6$ Å, $\beta = 102°$, $Z = 4$. The space groups and structures of these compounds have not been determined.

A. J. C. WILSON

548.736.5

1347. The crystal structure of amesite and its thermal decomposition. G. W. BRINDLEY, B. M. OUGHTON AND R. F. YOUELL. *Acta Cryst.*, **4**, 552–7 (*Nov.*, 1951).

548.736.5

1348. Manganiferous hoernesite and manganese-hoernesite from Långban, Sweden. O. GABRIELSON. *Ark. Min. Geol.*, **1**, 333–7 (*Paper* 11, 1951).

$(Mg, Mn)_3(AsO_4)_2 . 8H_2O$ occurs in radiating aggregates in small fissures in the Långban mine. The ratio of Mg to Mn varies from about 3 : 2 to 4 : 5. It is probably isotypic with bobierrite, $Mg_3(PO_4)_2 . 8H_2O$, which has the space group $P2_1/c$. The cell dimensions, from a powder photograph with Fe$K\alpha$ radiation, are $a = 10{\cdot}38$, $b = 28{\cdot}09$, $c = 4{\cdot}774$ Å, all $\pm 0{\cdot}05$ Å, $\beta = 105°40'$, $Z = 4$.

A. J. C. WILSON

548.737

1349. Rotation of *n*-butylic radical in crystalline state. T. ODA, K. SAKATA AND S. KONDO. Letter in *J. Chem. Phys.*, **19**, 1314 (*Oct.*, 1951).

A cubic face-centred lattice, unit edge 18·6 Å, was formed containing 8 units of $BaCa_2(CH_3CH_2CH_2COO)_6$, giving a crystal structure isomorphous with the propionate. J. JACOBS

548.737

1350. The structure of hydroxyproline. J. ZUSSMAN. *Acta Cryst.*, **4**, 493–5 (*Nov.*, 1951).

Orthorhombic ($P2_12_12_1$) with four molecules in cell, $a = 5{\cdot}01$, $b = 8{\cdot}35$, $c = 14{\cdot}1$ Å. Electron-density maps of two projections are presented. Details of the structure are compared with those observed in other compounds. A.

548.737

1351. The paracrystalline fine structure of natural and synthetic albumins. Visual approximation procedures for the determination of the deformation tensors of lattice cells. R. HOSEMANN. *Acta Cryst.*, **4**, 520–30 (*Nov.*, 1951) *In German.*

An "ideal paracrystal" is understood to be a deformation of the ideal, i.e. periodic, crystal structure, obtained by replacing the constant cell edges a_i by statistically determined vectors varying in both lengths and directions. The individual cells thereby become deformed, and so does their content. The theory of X-ray diffraction for this aperiodic arrangement is discussed by studying its Fourier transform. Only if the deformations of the cells are small will reflexions of different orders be clearly separated; in any case they will be bridged by intensity ridges between neighbouring reflexions. From the ratio of maximum to minimum intensity on a line connecting such reflexions it is possible to obtain the mean-square deviations of the cell edges (both in length and in direction) from the average values obtained from the positions of the reflexions. The theory is applied to the discussion of diagrams obtained by Bear and his co-workers on keratin and collagen and by Hess and Kiessig on polyurethane. In natural fibres these substances display a limited statistical variation in the length of the edge of the macrocell along the fibre axis, but a much larger variation in its orientation. In β-keratin it is still possible to recognize a pseudo-crystalline structure of the macro lattice, but α-keratin displays only a kind of nematic, and collagen of smectic, close-range order. Corresponding to this, two- or one-dimensionally discontinuous low-angle scattering is produced. In polyurethane the statistical variation in the macro lattice is so pronounced that the structure approximates to that of a cybotactic liquid and gives rise only to almost continuous low-angle scattering. The construction of the "ideal paracrystal" is found to be confirmed as a suitable model for the discussion of the X-ray effects. A.

548.74

1352. Anomalies of intensity and position in electron diffraction patterns. C. MENZEL-KOPP. *Ann. Phys.* [*Lpz.*] **9**, 259–83 (*No.* 5, 1951) *In German.*

Anomalies of intensity and position are observed when a convergent electron beam is diffracted by passing it through a crystal. Examples of this phenomenon are studied and an explanation is given of the way in which the anomalies observed depend on structure factor and geometry. J. THEWLIS

548.74

1353. Symmetrically obtained electron diffraction patterns. C. MENZEL-KOPP. *Ann. Phys.* [*Lpz.*] **9**, 284–92 (*No.* 5, 1951) *In German.*

It is to be expected that the electron diffraction pattern of a single crystal in a convergent electron beam should show, for symmetrical reflection, complete compensation of the Bragg reflections. That this occurs for the symmetry plane of mica but not

for the (331) plane is thought to arise as the result of the influence of a parallel pair of reflections from the (221) plane. J. THEWLIS

548.74 : 535.8

1354. Optical demonstration of electron-diffraction effects due to small particle size. W. G. BURGERS. *Acta Cryst.*, **4**, 502–3 (*Nov.*, 1951).

548.74 : 539.185

1355. The diffraction of thermal neutrons by single crystals. G. E. BACON. *Proc. Roy. Soc. A*, **209**, 397–407 (*Nov.* 7, 1951).

Experimental measurements of the intensity of neutron reflection by large single-crystal slices are shown to be in agreement with previously published calculations. It is demonstrated that accurate comparison can be made of the structure factors of planes in a zone by the use of cylindrical or pillar crystals, sufficiently small in diameter to give negligible secondary extinction effects. The use of single crystals for structure analysis is discussed. A.

548.74 : 539.185

Scattering of slow neutrons by a crystal lattice of ordered alloys. *See Abstr.* 1225

548.74 : 539.27

Techniques and applications of electron diffraction in industrial research. *See Abstr.* 1237

GEOPHYSICS 55

550.371

1356. On the method of measuring the earth's electric field. Effect of wind on radioactive collectors. R. MÜHLEISEN. *Z. Naturforsch.*, **6a**, 667–71 (*Nov.*, 1951) *In German.*

A valve voltmeter circuit is described for the measurement of the earth's vertical electric field by means of a polonium collector. Parallel measurements are made with identical collectors installed at varying distances from the wall of a building and from each other. The effect of wind on the overall and fine structures of the field registrations are discussed and the effects noted are checked by laboratory tests in which radioactive collectors in an artificial field are subjected to an air stream. Conclusions are drawn as to some precautions to be observed in order to reduce to a minimum the disturbing effect of field distortions due to the movement of ions produced by the collector itself. R. H. GOLDE

550.386

1357. A possible connection between certain metamorphic phenomena and anomalies in the earth's magnetic field. J. D. WEAVER. *Science*, **114**, 434–5 (*Oct.* 26, 1951).

Certain anomalies of the geomagnetic field appear related to areas disturbed geophysically, e.g. direct relationships appear between occurrences of earthquakes, vulcanism and local magnetic anomalies; and it is found also that mineral orientation (particularly in mica-bearing rocks) may be controlled by weak magnetic gradients. The need for further intensive research on these matters is stressed. D. R. BARBER

ATMOSPHERE . METEOROLOGY 551.5

551.501.4

1358. Selective annotated bibliography on constants, units, tables and diagrams. C. E. P. BROOKS. *Meteorol. Abstr.*, **2**, 289–318 (*April*, 1951).

The bibliography of 200 items is intended to include references to the main sources of data on physical constants required by meteorologists and to aids to computation, both tabular and graphical. It is divided into three sections: A. Constants, units and general works; B. Tables for conversion and reduction; C. Computing diagrams (including aerological diagrams), nomograms, slide rules. A.

551.501.8

1359. Vertical recording of rain by radar. S. K. H. FORSGREN AND O. F. PERERS. *Trans Chalmers Univ. Techn.* [*Gothenburg*] *No.* 107, 19 *pp.* (1951).

Description of 3 cm radar soundings, made in the summer of 1949, with brief discussion of the results in relation to precipitation theory. W. J. G. BEYNON

551.508.71

1360. On the lag of wet-bulb thermometers. F. RÖSSLER. *Z. Met.*, **4**, 274–84 (*Sept.*, 1950).

The mathematics of lag of dry and wet bulb thermometers is set out. Their coefficients of inertia are related (for water) by σ_f (wet bulb) $= \sigma$ (dry bulb)$/A$ where $A = 1 + (1\,560/p)(dE/d\phi)$. E is v.p. in mm. A depends mainly on temperature. A large number of observations was made to check this, using bare bulb and bulb covered with different types of paper or material (wet and dry) with good results. A brief application is made to radiosonde ascents. METEOROLOGICAL ABSTRACTS

551.510.4

1361. Arosa measures of ozone concentration in the lower troposphere, and their annual variation. F. W. P. GÖTZ AND F. VOLZ. *Z. Naturforsch.*, **6a**, 634–9 (*Nov.*, 1951) *In German.*

Records of O_3 content of the atm. at Arosa (1 860 m) since March 1950 are charted; and the variations are discussed in relation to the prevailing meteorological conditions. D. R. BARBER

551.510.4

1362. Understanding of the distribution of atmospheric ozone [derived] from the use of lunar eclipses. H.-K. PAETZOLD. *Z. Naturforsch.*, **6a**, 639–48 (*Nov.*, 1951) *In German.*

The basis of the evaluation of the vertical distribution of atm. O_3, as derived from the results of spectrophotometry of lunar eclipses, is outlined; and the results to date are discussed in relation to those obtained by independent methods, e.g. balloon

spectrographs, and utilization of the "Umkehr-effekt." D. R. BARBER

551.510.53

1363. Some phenomena of the upper atmosphere. S. CHAPMAN. *Proc. Phys. Soc.* [*Lond.*] *B*, **64**, 833–44 (*Oct.*, 1951).

The main gross uncertainty regarding composition at high levels relates to the proportion of atomic N present. Besides the major constituents that chiefly determine the mean molecular weight, there are important constituents, such as ozone, sodium and hydroxyl, which reveal their presence by their absorption or emission spectra; and there are others whose presence can be inferred from theirs. The composition of the atmosphere changes by escape from the top (H and He) and, by addition, from below (e.g. He and CO_2) and, as shown by the auroral spectrum, from above (H); cosmic rays also both add to the atmosphere and produce changes of composition by nuclear reactions. Near the magnetic equator there are important ionospheric phenomena not yet fully explored and explained. Among these one of the most interesting is the abnormal intensification of electric current flow, specially notable over Huancayo in Peru. A.

551.510.535

1364. On statistics of the abnormal nocturnal *E*-layer. E. A. LAUTER. *Z. Met.*, **4**, 234–40 (*July–Aug.*, 1950).

Sudden increases of ionization in *E*-layer were investigated through the ratio β_E (space wave/ground wave) for 1 250 m Potsdam transmission. Daily values of magnetic disturbance K and β_E are plotted in 27-day periods Nov. 1947–May 1950. Minimum β_E follows 3 days after maximum K. In 14/73 cases no marked absorption followed maximum K but there was a secondary maximum K instead. Five cases are examined specially, including high level radiation. Observations show that ionization must be due to solar corpuscular charged radiation of 200–300 km/sec, penetrating below 100 km.

METEOROLOGICAL ABSTRACTS

551.510.535

1365. On the statistical nature of the ionosphere. YA L. ALPERT AND A. A. AÍNBERG. *Zh. Eksper. Teor. Fiz.*, **21**, 389–400 (*No.* 3, 1951) *In Russian.*

Periodogram analysis of radio waves originating from the F_2-layer suggests that a large part of the emission is of a random, or "statistical," nature. The ratio of energies of the systematic to the random components is estimated and it is inferred that this ratio varies with the hour of day. The theoretical model employed assumes that the systematic component is simple harmonic in time. N. L. JOHNSON

551.510.535

1366. On certain characteristics of the *E* region of the ionosphere. K. RAWER AND E. ARGENCE. *C.R. Acad. Sci.* [*Paris*] **233**, 1208–10 (*Nov.* 12, 1951) *In French.*

On the assumption that the layer is formed by photoionization of the O_2 molecule, measurements of *E*-layer ionization are used to calculate values of effective cross-section and number of quanta. The results are compared with those given by Penndorf [Abstr. 6598 (1949)]. W. J. G. BEYNON

551.510.535

1367. A 16 kW panoramic ionospheric recorder. R. LINDQUIST. *Trans Chalmers Univ. Techn.* [*Gothenburg*] 40 *pp.* (*No.* 109, 1951).

Detailed description, with sample records, of a panoramic ionospheric recorder covering the frequency range 1–20 Mc/s. W. J. G. BEYNON

551.510.535 : 538.566.3

Radio-wave propagation in the ionosphere. *See Abstr.* 1134–6

551.521.1

1368. Global radiation of the sun. M. NICOLET AND R. DOGNIAUX. *Inst. Roy. Met. Belge Mem.*, *No.* 47, 50 *pp.* (1951) *In French.*

By global radiation is understood the radiation received direct from the sun and that scattered by the atmosphere. The formula developed takes account of variations of global radiation due to fluctuations connected with duration of insolation and length of day. Global radiation is calculated for periods of 10 hours. Comparison with measured results shows that the calculation is valid to $\pm$ 10%. An analysis of the results indicates the region of validity of the classical formula of Ångström. Its application is not permissible for fractions of insolation below 0·3 and, in our latitudes, for negative declination of the sun. Finally the radiation from the overcast sky cannot be determined by the classical formula. R. S. READ

551.521.3

1369. Investigation on the atmospheric absorption of the solar radiation at Rome. M. A. GIANNUZZI. *Atti. Acad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **11**, 193–8 (*Sept.–Oct.*, 1951) *In Italian.*

Monthly and ten-day averages of the coefficient of absorption of solar radiation at Mount Mario (Rome) are given for the years 1935 to 1945 and 1945 to 1950. M. DOPORTO

551.578.4 : 551.594.25

1370. Ice nucleus formation by dielectric polarization. W. RAU. *Z. Naturforsch.*, **6a**, 649–57 (*Nov.*, 1951) *In German.*

Suitable electrode arrangements for an electric field in air confirm that dielectric polarization is a reality and frozen nuclei or violent oscillation can be excluded. This ice formation occurs even from −1°C. The necessary field strength depends inversely upon the temperature of supercooling and upon the purity of the water. It is characteristic that very finely divided ice particles exist simultaneously in a drop and that they are orientated with a diagonal along the lines of the field. The drying effect of the frozen nucleus and the union of the supercooled drop with the dry nucleus (the first maximum of the frost nucleus spectrum) can be explained by the formation of a double layer connected with dielectric polarization. This electric ice formation can occur also in the atmosphere with high fields, and frozen nuclei are then supercooled. Also with the Lenard effect of water drops, ice formation can occur as soon as supercooled water drops occur. R. S. READ

551.591 : 551.508.92

1371. Visibility observation, measurement. L. FOITZIK. *Z. Met.*, **5**, 1–14 (*Jan.*, 1951).

Describes an experiment in determining visibility by day to an accuracy of at least 10% using about 50 objects classified into 8 sectors, 10 logarithmic intervals of distance, and 5 degrees of visibility. Visibility in km is given by (distance of object) × (visibility factor). Selection of objects during 2 hr after sunset is examined (moonlit, moonless, cloudy). The meaning of visibility is considered with reference to 4 types of visibility meter, but the use of natural objects is considered preferable except for very limited horizons. At night, photometry of lights is preferred. For continuous day and night work author advocates light-transmission apparatus over a few hundred meters. He gives examples of autographic 24-hr records on 4 selected days.

METEOROLOGICAL ABSTRACTS

551.594.5 : 535.338.4

Atmospheric oxygen bands in emission from neon-oxygen mixtures, and in night sky and auroral luminescences. *See Abstr.* 880

BIOLOGY 57/59

MEDICAL SCIENCE . HUMAN PHYSIOLOGY 61

613.644 : 534.39

Physiological effects produced by the noise of aeroplane propellors. *See Abstr.* 852

615.849 : 778.34 : 539.185.7

Use of nuclear research emulsions for fast-neutron dosimetry. *See Abstr.* 1226

616–073.75 : 537.542

1372. A method of making visible the distribution of activity in a source of ionizing radiation. W. V. MAYNEORD, R. C. TURNER, S. P. NEWBERY AND H. J. HODT. *Nature* [*Lond.*] **168**, 762–5 (*Nov.* 3, 1951).

A well-canalized counter receives radiation from a small angular region of a radioactive body. Two motor-driven cams give the counter horizontal and vertical movements, enabling it to scan the radioactive body. The instantaneous counting rate will be proportional to the radioactivity "seen" at any moment. The radioactive picture received in the scanning counter is passed through a pulse shaping circuit and applied to c.r.t. indicators. Rotary switches, attached to the driving motor of the counter, apply steps of voltage to the c.r.t. deflecting plates appropriate to the position of the scanning head, thus producing a matrix for reception of the radioactive picture. Pictures of radioactive sources using a 100-spot matrix are shown. Theoretical discussion is given, and the possibility of using the apparatus for amplifying X-ray images is foreseen. D. V. MABBS

PHOTOGRAPHY 77

771.3 : 53.087.5

1373. A continuous motion camera for multiple exposure of 35 mm film. E. L. R. WEBB. *Canad. J. Techn.*, **29**, 401–5 (*Sept.*, 1951).

It makes possible the economical recording, at 4 in per sec, of transient signals by the method of photographing the deflection modulated spot of a cathode-ray tube. The film is passed through the camera 20 times, writing one wavy line each trip, and thus recording 2 000 ft of information on a standard 100 ft roll of film. Various features of automatic operation are included. A.

778.33 : 537.531

1374. Electronic amplification of the roentgenoscopic image. P. C. HODGES AND L. S. SKAGGS. *Amer. J. Roentgenol. Radium Ther.*, **66**, 705–11 (*Nov.*, 1951).

The present position of Moon's amplification system, using a scanning X-ray tube [Abstr. 3634 (1949)] is described. Ultimate aims are: the focal spot of the electron beam must approximate to a mathematical point, and the tube must run continuously at 100 mA and 125 kV. This is thought to be possible because of the speed with which the target is scanned. The design of an X-ray tube, hoped to meet these requirements, is detailed. Screen materials, and a new photo-multiplier tube, are discussed. The system is still in an early experimental stage, but it has produced promising results on a small scale. D. V. MABBS

778.33 : 539.166

Some aspects of cobalt radiography. *See Abstr.* 1206

778.34 : 537.534.74

1375. The surface loss correction for nuclear emulsions. S. L. MARTIN. *Aust. J. Sci. Res. A*, **4**, 296–304 (*Sept.*, 1951).

When nuclear emulsions are used in the investigation of the angular distributions of scattered particles those tracks which pass through the emulsion surface cannot be accepted for measurement and in consequence the observed angular distribution must be corrected to allow for this. In the present paper, formulae are developed for the case of particles recoiling from a mono-energetic beam of particles incident at any angle on the surface. The effect of small-angle scattering is neglected but on the basis of work done by Powell and Occhialini it is believed that the formulae are valid for recoil energies at least as great as 5 MeV. Curves are given from which the factor can be obtained in any given case. A.